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OF THE

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VOLUME LV.

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FRIDAY, NOVEMBER 23, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

ONE-HUNDRED-AND-FIFTY-THIRD SESSION, 1906-7.

SESSIONAL ARRANGEMENTS.

The Opening Meeting of the One-hundred-and-Fifty-Third Session was held on Wednesday Evening, the 21st of November, when an Address was delivered by Sir STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

NOVEMBER 28.—JOHN WILLIAM GORDON, "Patent Law Reform." SIR WILLIAM H. PREECE, K.C.B., F.R.S., will preside.

DECEMBER 5.—COLONEL SIR CHARLES M. WATSON, K.C.M.G., C.B., "The Metric System." SIR DAVID GILL, K.C.B., F.R.S., will preside.

DECEMBER 12.—CECIL H. HOOPER, Member of the Council of the National Fruit-Growers' Asssociation, "Fruit Growing and the Protection of Birds."

" 19.—ALBERT E. HUMPHRIES, President of the Incorporated Association of British and Irish Millers, "Modern Developments of Flour-Milling." THOMAS HUDSON MIDDLETON, M.A., Professor of Agriculture, Cambridge University, will preside.

Papers to be read after Christmas:—

PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company, "The Straits of Panama."

THOMAS EMLEY YOUNG, B.A., Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association, "The Principles and Practice of Insurance, and their modern Develep ments."

JOHN B. C. KERSHAW, F.I.C., "Smoke Prevention in Factories."

CLAYTON BEADLE, "The Underground Water Supply of the Thames Basin."

J. CRAIG ANNAN, "Engraving and Photogravure."

NOEL HEATON, B.Sc., "Mediæval Stained Glass, its Production and Decay."

HAL WILLIAMS, "Cold Storage and Food Supply."

ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts, "Modern Typewriters and Accessories."

COLONIAL SECTION.

Tuesday Afternoons, at 4.30 o'clock:—

DECEMBER 4.—THE HON. SIR LEWIS LLOYD MICHELL, "The Cape to Cairo Railway." THE RIGHT HON. VISCOUNT MILNER, G.C.B., G.C.M.G., will preside.

January 15, March 5, May 7.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 13.—A. YUSUF ALI, M.A., LL.M., Cantab, I.C.S., "The Indian Mohammedans: their Past, Present, and Future." LORD AMPTHILL, G.C.S.I., G.C.I.E., will preside.

January 24, February 14, March 14, April 25, May 30.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

DECEMBER 18.—THOMAS OKEY, "Basket Making." LEWIS FOREMAN DAY, F.S.A., will preside.

January 29, February 19, March 19, April 30, May 28.

CANTOR LECTURES.

Monday evenings at 8 o'clock:—

A. D. HALL, M.A., Director of Lawes Agricultural Trust, "Artificial Fertilisers: their Nature and Functions." Five Lectures.

LECTURE I.—NOVEMBER 19.—*The Nutrition of the Plant.*—General principles of the nutrition of plants—Photosynthesis and the utilisation of solar energy—Nitrogen assimilation—The ash-constituents, necessary and non-necessary—The soil and its composition—Its power of supplying certain of the crop constituents but not all—The function of a fertiliser—History of the introduction of artificial fertilisers.

LECTURE II.—NOVEMBER 26.—*The Fixation of Nitrogen.*—The plant's dependence upon a supply of combined nitrogen—How has the general supply of combined nitrogen in the world arisen?—Inorganic agencies trifling—Action of bacteria, in symbiosis with leguminous plants, or free in the soil—Energetics of nitrogen fixation: source of energy in the combustion of carbohydrate formed by photo-synthesis—Attempts to increase the fixation by bacteria in the soil—Fixation of nitrogen as a manufacturing process—The calcium nitrate and nitric acid processes—Calcium cyanamide—Price dependent upon the cost of power—How far can the farmer render himself independent of nitrogen fertilisers?

LECTURE III.—DECEMBER 3. —*Nitrogenous Fertilisers.*—Nature, origin and preparation :—Sodium nitrate—Ammonium sulphate—Guanos—Waste products: Shoddies, oil seed residues, &c.—The bacterial process in the soil by which these materials are prepared for the plant—Statistics of their comparative activity and recovery by the crop—Function of nitrogen as a fertiliser.

LECTURE IV.—DECEMBER 10.—*Phosphatic Fertilisers.*—The requirements by soil and crop of phosphoric acid, its function as a fertiliser—Solubility of various phosphates—The utilisation of natural phosphates—Bones: various forms; source of supply—Superphosphate from mineral phosphates—Manufacture—Sources of the material—Basic slag as a waste product in the manufacture of steel by the Thomas-Gilchrist basic process—Its special value on certain types of land.

LECTURE V.—DECEMBER 17.—*Potassic Fertilisers. Consumption of Fertilisers.*—Potassic fertilisers, their function. Large store of potash in most soils—The Stassfurth potash deposits and the manufacture of potash manures therefrom—Examples of the value of potassic fertilisers—The part played by lime and calcium carbonate in the retention of fertilisers by the soil, and their utilisation by the plant—The farmer's fertiliser bill. Should it be increased?—Partly a question of prices, intensive farming only profitable when prices are high—Partly a question of education, if the manure now used were more carefully bought and more skilfully adjusted to soil and crop, the greater profit would justify an increased purchase.

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.
January 28; February 4, 11.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.
February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.
April 15, 22, 29.

JUVENILE LECTURES.

Wednesday Evenings, January 2 and 9, 1907, at 5 o'clock.
"Perils and Adventures Underground." By BENNETT H. BROUGH.

CONVERSAZIONE.

The Annual Conservazione of the Society will probably be held on Tuesday, July 2, 1907. Each member is entitled to a card for himself, and one for a lady.

PROCEEDINGS OF THE SOCIETY.

CHARTER.—THE SOCIETY OF ARTS was founded in 1754, and incorporated by Royal Charter in 1847, for "The Encouragement of the Arts, Manufactures, and Commerce of the Country, by bestowing rewards for such productions, inventions, or improvements as tend to the employment of the poor, to the increase of trade, and to the riches and honour of the kingdom; and for meritorious works in the various departments of the Fine Arts; for Discoveries, Inventions, and Improvements in Agriculture, Chemistry, Mechanics, Manufactures, and other useful Arts; for the application of such natural and artificial products, whether of Home, Colonial, or Foreign growth and manufacture, as may appear likely to afford fresh objects of industry, and to increase the trade of the realm by extending the sphere of British commerce; and generally to assist in the advancement, development, and practical application of every department or science in connection with the Arts, Manufactures, and Commerce of this country."

THE SESSION.—The Session commences in November, and ends in June.

ORDINARY MEETINGS.—At the Wednesday Evening Meetings during the Session, papers on subjects relating to inventions, improvements, discoveries, and other matters connected with the Arts, Manufactures, and Commerce of the country are read and discussed.

INDIAN SECTION.—This Section was established in 1869, for the discussion of subjects connected with our Indian Empire. Six or more Meetings are held during the Session.

COLONIAL SECTION.—The Section was formed in 1874 under the title of the African Section, for the discussion of subjects connected with the Continent of Africa. It was enlarged in 1879, so as to include the consideration of subjects connected with our Colonies and Dependencies. Four or more Meetings are held during the Session.

APPLIED ART SECTION.—This Section was formed in 1886, for the discussion of subjects connected with the industrial applications of the Fine Arts. Six or more Meetings are held during the Session.

CANTOR LECTURES.—These Lectures originated in 1863, with a bequest by the late Dr. Cantor. There are several Courses every Session, and each course consists of from two to six Lectures.

ADDITIONAL LECTURES.—Special Courses of Lectures are occasionally given.

JUVENILE LECTURES.—A Short Course of Lectures, suited for a Juvenile audience, is delivered to the Children of Members during the Christmas Holidays.

ADMISSION TO MEETINGS.—Members have the right of attending the above Meetings and Lectures. They require no tickets, but are admitted on signing their names. Every Member can admit *two* friends to the Ordinary and Sectional Meetings, and *one* friend to the Cantor and other Lectures. Books of tickets for the purpose are supplied to the Members, but admission can be obtained on the personal introduction of a Member. For the Juvenile Lectures special tickets are issued.

JOURNAL OF THE SOCIETY OF ARTS.—The *Journal*, which is sent free to Members, is published weekly, and contains full Reports of all the Society's Proceedings, as well as a variety of information connected with Arts, Manufactures, and Commerce.

EXAMINATIONS.—Examinations, founded in 1853, are held annually by the Society, through the agency of Local Committees, at various centres in the country. They are open to any person. The subjects include the principal elements of Commercial Education, and Music. Full particulars of the Examinations can be had on application to the Secretary.

LIBRARY AND READING-ROOM.—The Library and Reading-room are open to Members, who are also entitled to borrow books.

CONVERSAZIONI are held, to which Members are invited, each Member receiving a card for himself and a lady.

MEMBERSHIP.

The Society numbers at present nearly four thousand Members. The Annual Subscription is Two Guineas, payable in advance, and dates from the quarter-day preceding election; or a Life Subscription of Twenty Guineas may be paid. There is no Entrance Fee.

Candidates for Membership are proposed by Three Members, one of whom, at least, must sign on personal knowledge; or are nominated by the Council.

Every Member whose subscription is not in arrear is entitled .—

To be present at the Meetings of the Society, and to introduce two visitors at such meetings, subject to such special arrangements as the Council may deem necessary to be made from time to time.

To be present and vote at all General Meetings of the Society.

To be present at the Cantor and other Lectures, and to introduce one visitor.

To have personal free admission to all Exhibitions held by the Society at its house in the Adelphi.

To be present at all the Society's *Conversazioni*.

To receive a copy of the weekly *Journal* published by the Society.

To the use of the Library and Reading-room.

All subscriptions should be paid to the Secretary, Sir Henry Trueman Wood, and all Cheques or Post-office Orders should be crossed "Coutts and Company," and forwarded to him, at the Society's House, John-street, Adelphi, London, W.C.

HENRY TRUEMAN WOOD, *Secretary.*

CALENDAR FOR THE SESSION.

The following is the Calendar for the Session 1906-1907. It is issued subject to any necessary alterations:—

NOVEMBER, 1906.

1	Th	
2	F	
3	S	
4	**S**	
5	M	
6	Tu	
7	W	
8	Th	
9	F	
10	S	
11	**S**	
12	M	
13	Tu	
14	W	
15	Th	
16	F	
17	S	
18	**S**	
19	M	Cantor Lecture I. 1
20	Tu	
21	W	First Ordinary Meeting
22	Th	
23	F	
24	S	
25	**S**	
26	M	Cantor Lecture I. 2
27	Tu	
28	W	Ordinary Meeting
29	Th	
30	F	

DECEMBER, 1906.

1	S	
2	**S**	
3	M	Cantor Lecture I. 3
4	Tu	Colonial Section
5	W	Ordinary Meeting
6	Th	
7	F	
8	S	
9	**S**	
10	M	Cantor Lecture I. 4
11	Tu	
12	W	Ordinary Meeting
13	Th	Indian Section
14	F	
15	S	
16	**S**	
17	M	Cantor Lecture I. 5
18	Tu	Applied Art Section
19	W	Ordinary Meeting
20	Th	
21	F	
22	S	
23	**S**	
24	M	
25	Tu	CHRISTMAS DAY
26	W	*Bank Holiday*
27	Th	
28	F	
29	S	
30	**S**	
31	M	

JANUARY, 1907.

1	Tu	
2	W	Juvenile Lecture I.
3	Th	
4	F	
5	S	
6	**S**	
7	M	
8	Tu	
9	W	Juvenile Lecture II.
10	Th	
11	F	
12	S	
13	**S**	
14	M	
15	Tu	Colonial Section
16	W	Ordinary Meeting
17	Th	
18	F	
19	S	
20	**S**	
21	M	
22	Tu	
23	W	Ordinary Meeting
24	Th	Indian Section
25	F	
26	S	
27	**S**	
28	M	Cantor Lecture II. 1
29	Tu	Applied Art Section
30	W	Ordinary Meeting
31	Th	

FEBRUARY, 1907.

1	F	
2	S	
3	**S**	
4	M	Cantor Lecture II. 2
5	Tu	
6	W	Ordinary Meeting
7	Th	
8	F	
9	S	
10	**S**	
11	M	Cantor Lecture II. 3
12	Tu	
13	W	Ordinary Meeting
14	Th	Indian Section
15	F	
16	S	
17	**S**	
18	M	
19	Tu	Applied Art Section
20	W	Ordinary Meeting
21	Th	
22	F	
23	S	
24	**S**	
25	M	Cantor Lecture III. 1
26	Tu	
27	W	Ordinary Meeting
28	Th	

MARCH, 1907.

1	F	
2	S	
3	**S**	
4	M	Cantor Lecture III. 2
5	Tu	Colonial Section
6	W	Ordinary Meeting
7	Th	
8	F	
9	S	
10	**S**	
11	M	Cantor Lecture III. 3
12	Tu	
13	W	Ordinary Meeting
14	Th	Indian Section
15	F	
16	S	
17	**S**	
18	M	
19	Tu	Applied Art Section
20	W	Ordinary Meeting
21	Th	
22	F	
23	S	
24	**S**	
25	M	
26	Tu	
27	W	
28	Th	
29	F	GOOD FRIDAY
30	S	
31	**S**	EASTER SUNDAY

APRIL, 1907.

1	M	*Bank Holiday*
2	Tu	
3	W	
4	Th	
5	F	
6	S	
7	**S**	
8	M	
9	Tu	
10	W	Ordinary Meeting
11	Th	
12	F	
13	S	
14	**S**	
15	M	Cantor Lecture IV. 1
16	Tu	
17	W	Ordinary Meeting
18	Th	
19	F	
20	S	
21	**S**	
22	M	Cantor Lecture IV. 2
23	Tu	Colonial Section
24	W	Ordinary Meeting
25	Th	
26	F	
27	S	
28	**S**	
29	M	Cantor Lecture IV. 3
30	Tu	Applied Art Section

MAY, 1907.

1	W	Ordinary Meeting
2	Th	Indian Section
3	F	
4	S	
5	**S**	
6	M	
7	Tu	
8	W	Ordinary Meeting
9	Th	
10	F	
11	S	
12	**S**	
13	M	
14	Tu	
15	W	Ordinary Meeting
16	Th	
17	F	
18	S	
19	**S**	WHIT SUNDAY
20	M	*Bank Holiday*
21	Tu	
22	W	
23	Th	
24	F	
25	S	
26	**S**	
27	M	
28	Tu	Applied Art Section
29	W	Ordinary Meeting
30	Th	Indian Section
31	F	

JUNE, 1907.

1	S	
2	**S**	
3	M	
4	Tu	
5	W	
6	Th	
7	F	
8	S	
9	**S**	
10	M	
11	Tu	
12	W	
13	Th	
14	F	
15	S	
16	**S**	
17	M	
18	Tu	
19	W	
20	Th	
21	F	
22	S	
23	**S**	
24	M	
25	Tu	
26	W	Annual General Meeting
27	Th	
28	F	
29	S	
30	**S**	

The Cantor Lectures will commence at Eight o'clock.

The Ordinary Meetings will commence at Eight o'clock.

The Meetings of the Indian Section and the Colonial Section will commence at Half-past Four o'clock.

The Meetings of the Applied Art Section will commence at Half-past Four or Eight o'clock.

The Annual General Meeting will be held at Four o'clock.

The Juvenile Lectures will be given at Five o'clock.

NOTICES.

H.M. THE KING OF NORWAY.

The Council of the Society having elected H.M. the King of Norway an Honorary Royal Member, H.R.H. the Prince of Wales, as President of the Society, graciously communicated to King Haakon the fact of his election, and has now received from His Majesty the following letter of acceptance :—

Windsor Castle,
November 15, 1906.

SIR,—In reply to your Royal Highness's letter, dated November, 1906, I beg to assure you that I shall have great pleasure in being enrolled an Honorary Royal Member of the Society of Arts.

I much value the compliment thus paid to me, and I shall be proud in being associated with an Institution so old and so distinguished, and over which your Royal Highness now presides.

I have the honour to be, Sir,
Your Royal Highness's most
faithful servant,
(Signed) HAAKON R.

To His Royal Highness
The Prince of Wales, K.G.

CANTOR LECTURES.

On Monday evening, 19th inst., Mr. A. D. HALL, M.A., Director of the Lawes Agricultural Trust, delivered the first lecture of his course on "Artificial Fertilisers : their Nature and Functions."

The lectures will be published in the *Journal* during the Christmas recess.

MORRIS'S CANTOR LECTURES ON INDIA RUBBER.

The Cantor Lectures of Sir Daniel Morris, K.C.M.G., on the "Plants yielding Commercial India Rubber" (1898), which have long been out of print, have now been reprinted, and are on sale at the price of two shillings each. The pamphlet can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

FIRST ORDINARY MEETING.

Wednesday, November 21st, 1906; SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council, in the chair.

The following members were proposed for election as members of the Society :—

Adams, Miss Katharine, Eadburgha Bindery, Broadway R.S.O., Worcestershire.
Addis, Frederick Henry, Assoc.M.Inst.C.E., B.B. and C.I. Railway, Mhow, Central India.
Akimoto, Viscount, 6 Kita Koga-cho, Surugadai, Tokyo, Japan.
Araki, Professor Kwampo, 3 Nishimachi, Shitaya, Tokyo, Japan.
Armstrong, Miss Carr, R.M.S., 76, Longridge-road-mansion, Earl's-court, S.W.
Asano, Sōichiro, 18, Kitashinbori-cho, Nihonbashi-ku, Tokyo, Japan.
Baillie, Mrs. A. H. Murray, 94, Eaton-place, S.W.
Baxter, Walter Stephen, 38, Mayflower-road, Clapham, S.W.
Beatson, E. B., Vicarsgrange, Eastbourne.
Bebianno, Domingos Alves, care of Mark Sutton, 130*a*, Rua Barão de Mesquita, Andarahy Grande, Rio de Janeiro, Brazil, South America.
Beech, Ernest William, 32, Lincoln-road, Peterborough.
Bisset, William Molteno, Colonial Mutual-buildings, Adderley-street, Cape Town, South Africa.
Blount, Lady E. A. M., F.R.S.L., 73, West-street, Brighton.
Bonner, Albert Edward, 18, Holland-street, Kensington, W.
Bonnor, John H. M., 10, Trafalgar Studios, Manresa-road, Chelsea, S.W.
Boright, Sherman H., Forbes Reef, Swazieland, South Africa.
Box, Eliab, 287-289, Broadway, Bexley-heath, Kent.
Brown, Miss Charlotte, 115, Gloucester-road, S.W.
Buck, James Henry Edward, A.M.I.Mech.E., P.O. Box 1,049, Johannesburg, Transvaal, South Africa.
Buckton, William Woodyer, B.A., 72, Victoria-street, S.W., and Royal Societies' Club, St. James's-street, S.W.
Bultitude, Henry Frank, 18, Philip-road, Peckham-rye, S.E.
Campbell, Richardson, Dunedin, Woodlands-street, Cheetham-hill, Manchester.
Carter, Major Evan E., C.M.G., M.V.O., Stanhope Lines, Aldershot.
Cartlidge, S. J., 9, Netherton-grove, Chelsea, S.W.
Chambers, James S., Kutais, Trans-Caucasus, and 5, Ionkovskafa, St. Petersburgh, Russia.
Chapin, Robert Williams, 28, Bishopsgate-street Within, E.C.
Choles, Major Frederick John, Ordnance Officer, Natal Militia, Pietermaritzburg, Natal, South Africa.

Chow, Taotai C. L., Imperial Railways of North China, Tientsin, China.

Clemens, Benjamin, 23, Fitzroy-square, W.

Collingwood, John James, Clovelly, Cecil-road, Upton Manor, E.

Cooper, J. Paul, The Elms, Castle Bromwich, Warwickshire.

Corkett, Frederic Thomas, 3, Redcliffe-gardens, Ilford, Essex.

Crocker, Ernest George, A.M.I.Mech.E., H.M. Naval Establishment, Rosyth, Fife, N.B.

Croll, James, Olaa Sugar Company, Limited, Olaa, Hawaii.

Cross, Reginald Thomas Green, A.M.I.Mech.E., Khoreel Tea Estate, Daloo P.O., Cachar, India.

Damania, Lieut.-Colonel P. J., Northbrook Society, 185, Piccadilly, W.

Davidson, Rev. William, The Manse, Chryston, by Glasgow.

Davies, James Bright, Northern Nigeria Enclave, Burutu, Southern Nigeria, West Africa.

Divecha, Ramchundra Nursey, A.M.I.Mech.E., Sugar-lane, Kaloopur Post, Ahmedabad, India.

Dixon, G. E., M.D., Heathfield, Chislehurst, Kent.

Dressler, Conrad, White-cottage, Marlow, Bucks.

Dyce, James S., Barberton, Transvaal, South Africa.

Eddy, Sidney Arthur, Carn Brea-house, Observatory, Cape Town, South Africa.

Emanuel, Frank L., 67, Ladbroke-grove, Kensington, W.

Etti, Captain Charles, M.A., The European Eastern Asia Trader Association, Limited, West India House, 98, Leadenhall-street, E.C.

Fisher, Henry Heibert, Calle Zapiola 2,075, Belgrano, Buenos Aires, Argentine Republic.

Fitton, Hedley, A.R.E., Stile-house, Haslemere, Surrey.

Flockhart, William, F.R.I.B.A., 180, New Bond-street, W.

Foley, J. E., Imperial Railways of North China, Tientsin, China.

Foster, Richard, M.A., J.P., D.L., Lanwithan, Lostwithiel, Cornwall.

Frankel, Alfred, Dunedin-house, Basinghall-avenue, E.C.

Fulton, Hon. Frederick John, K.C., Kamloops, British Columbia, Canada.

Garfield, Sergyei, "Ussuri Life" Office, Vladivostock, Siberia.

Gascoine, Edmund, Sir W. G. Armstrong, Whitworth and Co., Limited, 32, Great Peter-street, Westminster, S.W.

George, William Carlisle, Ecole Khédiviale d'Arts et Metiers, Cairo, Egypt.

Ghosh, Dr. Jogesh Chandra, L.M.S., L.C.P.S., College of Physicians and Surgeons, 3, Wellesley-street, Calcutta, India.

Gollin, Alfred, 561, Bourke-street, Melbourne, Victoria, Australia.

Gowen, Rev. Herbert H., Trinity Parish Church, Seattle, Washington, U.S.A.

Greenwell, Allan, F.G.S., Assoc.M.Inst.C.E., 30-31, Furnival-street, Holborn, E.C.

Hannon, Patrick Joseph Henry, Department of Agriculture, Capetown, South Africa.

Hartness, John A., Jones and Lamson Machine Company, 97, Queen Victoria-street, E.C.

Hartrick, Archibald Standish, 8, Wentworth Studios, Manresa-road, Chelsea, S.W.

Hatton, Major-General Villiers, C.B., 34, Charles-street, Berkeley-square, W.

Hodson, Arthur J., Lodore, Southborough-road, Chelmsford.

Hope, Charles E., Messrs. Hope, Graveley and Co., 322, Cambie-street, Vancouver, British Columbia, Canada.

How, William, 19, Calverley-park, Tunbridge Wells, Kent.

Inouyé, K., 54, Ichiban-chō Kojimachi, Tokyo, Japan.

Johnson, Hon. F. E. R., Monrovia, Liberia, West Africa.

Jones, George Edward, 25, Lexham-gardens, S.W.

Jones, William Henry Matthews, The Town-hall, Chester.

Keely, Royal R., City Engineer, Edmonton, Alberta, Canada.

Keen, Percy, 3 Queen's-mansions, Victoria-street, S.W.

Kimura, Professor Shunkichi, Ph.D., Naval Ordnance Depôt, Yokosuka, Sami, Japan.

King, Henry Douglas, 52, Queensborough-terrace, W.

Kitchin, Vernon Parry, B.A., The Priory, Watford, Herts.

Lal, Hira, 25, Mott's-lane, Calcutta, India.

Lavan, Lloyd Thomas, L.D.S., 12, Old Burlington-street, W.

Lawrie, Peter Stanley, Koe Guan Co., 63 Beach-street, Penang, Straits Settlements.

Le Mesurier, James, The United Asbestos Oriental Agency, Limited, Singapore, Straits Settlements.

Lesher, Arthur Lawrence, Messrs. Lesher, Whitman and Co., Broadway, corner of Bond-street, New York, U.S.A.

Lindsay, James G., City Engineer, Guelph, Ontario, Canada.

Low Kim Pong, 86, Market-street, Singapore, Straits Settlements.

Lynch, Captain C. W. D., care of London and Westminster Bank, St. James's-square, S.W., and Kasempa, North Western Rhodesia, South Africa.

McClean, John Robinson, Rusthall-house, Tunbridge Wells, Kent.

McDiarmid, James, Winnipeg, Manitoba, Canada.

Mackay, Francis Duncan, Messrs. Leighton and Mackay, 544, Bartholome Mitre, Buenos Aires, Argentine Republic.

Mackintosh, Mrs. E. R., 79, Lancaster-gate, W.

McNaughton, John L., Rosemount, Buckie, N.B.

MacWatt, Major Robert Charles, M.B., B.Sc., I.M.S., care of Messrs. King, King and Co., Bombay, India.

Mallins, Charles William, 5, Strathmore-road, Newsham-park, Liverpool.

Marks, Arnold J., 17, Lansdowne-place, Hove, Sussex, and 54 and 55, London-wall, E.C.

Maud, Captain William Hartley, Norton-manor, near Taunton, Somerset, and 57, Eaton-square, S.W.

Merrall, Charles Eddington, 20, Grove-lane, Denmark-hill, S.E.

Miles, Laurence, Rose-bank, Strawberry-vale, Twickenham, Middlesex.

Millar, Rev. Ernest, M.A., Mengo, Uganda, East Africa, and Heathdown, Hampstead-heath, N.W.

Millett, Charles Walter, Abbotsford, Hampton-wick, Middlesex.

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Minihane, E. J., 5, Castelnau-row, Barnes, S.W.

Mitchell, Felix, 81, Burg-street, Cape Town, South Africa.

Mocatta, Owen, 31, Cumberland-place, Hyde-park, W., and Leyfield, Datchet, Berks.

Moore, Lieutenant A. Usborne, R.N., H.M.S. "Queen," care of General Post-office, E.C.

Mulla, Yusuf I., 28th Street, Rangoon, Burma.

Murphy, Edward Robert, Sports Club, 8, St. James's-square, S.W.

Nishizawa, Kimio, Dayeh Iron Mine Department, Hupeh, China.

Oberg, Gustaf Leonhard, Shanghai Mutual Telephone Company Limited, Shanghai, China.

O'Neil, Rodolph Stuart, 29, Bergholt-crescent, Amhurst-park, Stamford-hill, N.

Owen, Captain Roger Carmichael Robert, C.M.G., Sudan Agency, War Office, Cairo, Egypt, and Naval and Military Club, Piccadilly, W.

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Phené, John Samuel, LL.D., F.S.A., 32, Oakley-street, Chealsea, S.W.

Philipson-Stow, Robert, Blackdown-house, Fernhurst, Sussex.

Pibel, William Henry, The Roses, Salway-hill, Woodford-green, Essex.

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Plummer, J. H., care of Canadian Bank of Commerce, 60, Lombard-street, E.C., and Toronto, Canada.

Porter, Colonel Geoffrey Morehead, R.E., H.M. Mint, Calcutta, India.

Redwood, Bernard Boverton, B.A., 34, Crediton-road, South Hampstead, N.W.

Richardson, David Lester, 60, Allison-road, Hornsey, N.

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Roselieb, George, 9, Grafton-square, Clapham, S.W.

Rosenkrantz, Baron Arild, 18, Clareville-grove, Onslow-gardens, S.W.

Rous, Bartholomew, 53, Madeley-road, Ealing, W.

Sait, Hajee Ismail, Bangalore, India.

Sawtell, William Arthur, 39, Deauville-road, Clapham-park, S.W.

Seymour, L. N., D.D.S., L.D.S., 27, Grosvenor-street, W.

Shozaburo, Kubara, Nichome Nakanoshima, Osaka, Japan.

Smith, Eric S. A., Messrs. Boulton and Paul, Limited, Norwich.

Smith, George R., M.L.A., Thetford Mines, Quebec, Canada.

Smith, T. L., 346, Camden-road, N.

Stevens, Wm. Henry Pern, 34, Ashburn-place, S.W.

Stuart, James, Assam Bengal Railway Company, Limited, Chittagong, India.

Tabor, Francis Samuel, District Judge, Rai Bareli, Oudh, India.

Taylor, Arthur Williamson, Edmonton, Alberta, Canada.

Tildesley, F. J., General Post Office, Johannesburg, Transvaal, South Africa.

Twentyman, Harold E., M.I.Mech.E., Stoneham lodge, Tettenhall, Wolverhampton.

Vaidya, Jain, Johari Bazaar, Jaipur, Rajputana, India.

Van Boeschoten, J. G., Reserve Investment-buildings (P.O. Box 611), Pretoria, Transvaal, South Africa.

Vereker, Lieutenant Henry Gosset, R.N., Coloony, Craneswater-avenue, Southsea, Hants.

Vernon, William, Wyborne-gate, Birkdale, Southport, Lancs.

Vidyabhusan, Pundit Gauridatta Misra, Gauhati, Assam, India.

Vogel, Dr. J. Ph., Superintendent, Archæological Survey, Lahore, India.

Walker, Robert Lea, 15, Park-crescent, Southport, Lancs.

Wehner, Anthony Stephen, Bath-house, 57, Holborn-viaduct, E.C.

Whitworth, G. Clifford, Crowhurst, College-road, Upper Norwood, S.E.

Wilkinson, Andrew George, 73, Dudley-gardens, West Ealing, W.

Wong Man Poh, 19, Market-street, Singapore, Straits Settlements.

Wood, David William, 4, St. Andrew's-mansions, Clapton, N.E.

Woodhouse, Richard, Bonegate-hall, Brighouse, Yorks.

Wright, Thomas George, 3, Purton-road, Bristol.

Wrightson, Miss Lucy G., Ockenden, Cuckfield, Sussex.

Young, Mrs. H. E., care of Dr. H. E. Young, M.P.P., Parliament-buildings, Victoria, British Columbia, and Atlin, British Columbia, Canada.

The CHAIRMAN delivered the following

ADDRESS.

Our ancestors had some singular tastes. They loved to hear sermons. Mr. G. Russell, in his latest book "Social Silhouettes," speaks of it as a "base passion of our fallen nature," and accuses the clergy of pandering to instead of opposing it; but though this is exaggeration, you have only to read Pepys's Diary to see how the writer, whose morality left somethihg to be desired, pursued sermons with no less earnestness than other and less reputable pleasures. More than that, when they could not get the professional thing, our ancestors went out of their way to listen to amateur imitations, and caused chairmen of meetings, and presidents of societies, and other innocent persons to deliver "addresses" to them. I think and hope that public taste is changing; but we are a very conservative people, and it is because of these two facts (1) that our ancestors liked sermons, and (2) that we dislike change, that I, whose tastes do not lie in that direction, have to deliver the usual annual address to you this evening. With us, however, it is something more than a matter of custom. There is a specific rule which calls for it — the by-law being to the effect that the Chairman of the Council shall deliver an address to the Society at its first ordinary meeting after his election declaratory of the policy which the Council proposes to follow during his year of office. Accordingly, I find that at one time the annual addresses, after dealing with the losses sustained by the Society during the year through the death of distinguished members, and giving a retrospect of the subjects dealt with at the meetings of the past year, would go on to touch on the questions which were to be the subjects of papers during the ensuing session, or which the Chairman would like to have brought before the notice of the Council, with a view to the influence of the Society being brought to bear upon the Government and the Parliament. I may mention that, at the time I am speaking of (thirty to forty years ago) this influence was, or at least was supposed to be, considerable, and was certainly exerted more directly by means of deputations and written communications to Ministers, and by questions in the House, than is the case at the present day. For instance, I find in the proceedings for one year (1869) the following instances :— A committee appointed to watch over the interests of telegraphy and promote the efficiency of the system, owing to the Government taking over the management. The Council asked by the Secretary of State for India to obtain information on behalf of the Indian Government on the processes of cleaning and husking rice in Europe. The Colonial Office consult the Council on the subject of meat preserving. A special deputation sent to the Duke of Argyll to urge the appointment of a Minister of Agriculture for India, and that he should assist agricultural exhibitions in that country. Council invite the Prime Minister to facilitate the circulation by loan of art treasures. Council to bring pressure to bear on Government to lighten the postage rate on printed matter. While questions such as the above occupied the attention of the Council, it was not unreasonable that the Chairman should be expected to propound the policy of the coming year. How or when this practice changed I have not ascertained, but it seems as if the discussion of the Council's past and present policy tended naturally to become little more than a *resumé* of the previous year's annual report and a forecast of the papers for the ensuing year, and that consequently successive chairmen, most of whom have been specialists in some particular line, have found it more to the interest and advantage of their audience to discuss some interesting question connected with their own professional or personal specialty, rather than to adhere to the strict letter of the by-law; to give, in fact, a "paper," rather than the annual address on policy.

Now, for me the duty of following in the footsteps of my distinguished predecessors is hard. The only subject on which I can claim any special knowledge is that of India, and I should naturally have wished to take as the subject of my address the arts, manufactures, and commerce of India, but I find that when Major-General Sir Owen Tudor Burne was Chairman of the Council a few years ago he took this as the theme of his discourse and went so fully into it as to leave nothing but gleanings! Indeed he left not even gleanings. He covered the whole field and that with a reaping machine not a sickle. Goldsmith's epitaph applies to him in both its clauses.

Moreover in the subsequent years the Society has had very valuable papers on different aspects of the subject from Mr. Tozer and Mr. O'Conor, and on looking into the question I found that I could only say over again what had been better said before especially by my predecessor in the chair, Major-General Sir Owen Tudor Burne.

"Pereant qui ante nos nostra dixerunt." Bad luck to the men who appropriate our subjects by anticipation. But the fact remains that they have been appropriated and I have had to look elsewhere for a subject on which I might hope to interest you to-night. The subject I have chosen is the Indian Section of the Society of Arts, and I hope to interest you in it because I have taken a great interest in it myself, and if other members of the Society, besides those specially connected with India, can be induced to take interest in it, it still has I think great scope for usefulness in the future.

The Indian Section, or as it was at first called the Indian Committee, had its origin in a motion made in January, 1869, by Mr. Hyde Clarke. Mr. Hyde Clarke, who died in 1895, was, for many years, an active and useful member of the Society and its Council. A full obituary notice of him will be found in the March number of the Society's *Journal* for that year. An engineer by profession, he appears to have had no special connection with India, beyond being asked to advise on a telegraph system for that country. But he was a man of many original ideas, and of untiring energy in pushing his suggestions. The Society certainly owes to him the establishment of the Indian and Colonial Sections—the latter having been originally designated the African Section—as well as many other useful suggestions in connection with the Society's work.

As a consequence of Mr. Hyde Clarke's motion, there appeared in the *Journal* for January 29th, 1869, the following notice :—

COMMITTEE ON INDIA.

The Council have resolved that a Committee be formed "to organise meetings for the discussion of subjects connected with the Arts, Manufactures, and Commerce of our Indian Empire."

The following gentlemen have been already invited to serve on this Committee :—

Archibald Campbell.	C. H. Fielder.
George Campbell.	W. S. Fitzwilliam.
Edwin Chadwick, C.B., Member of Council of Society of Arts.	George Moffatt.
Hyde Clarke, Member of Council of Society of Arts.	Sir Robert Montgomery, K.C.B., Vice-President of the Society of Arts.
Sir Daniel Cooper, Bart., Member of Council of Society of Arts.	Colonel Sykes, M.P.
Sir William Denison.	Captain Edward Thackeray.
Maj.-Gen. Sir Vincent Eyre, C.B., Member of Council of Society of Arts.	Sir Charles Trevelyan, K.C.B.
	Dr. J. Forbes Watson.

In addition to these gentlemen, the East Indi Association has been requested to nominate three of its members to join the Committee.

The Secretary of the Society of Arts will be glad to receive the names of any members of the Society taking an interest in Indian questions, in order that they may be invited to attend the meetings above referred to.

The Committee met on 16th February, with Sir Vincent Eyre in the chair. Those who know the history of the Indian Mutiny will remember the brilliant services of Eyre in the relief of Arrah and the dispersal of the Dinapore mutineers. The other members were Sir William Denison, late Governor of Madras, Dr. Archibald Campbell, the companion of Dr. Hooker's scientific journeys in Sikkim, and late District Officer of Darjeeling, Mr. Fielder, Secretary of the Tea Association, and Mr. Hyde Clarke.

These gentlemen proposed that six conferences should be held during the session on various subjects, specially on Tea, Waste Lands, and Trade with Border States. They also suggested a large list of names of gentlemen to be asked to join the Committee. The list is interesting, and shows a notable combination of names conspicuous in the Indian world of the day, such as Sir Bartle Frere, Sir G. Campbell, Sir Ranald Martin, Sir R. Montgomery, Sir Henry Rawlinson, and Dr. Forbes Watson, with names conspicuous in the English world, such as Dr. Chadwick, Sir C. Wentworth Dilke, James Fergusson, the archæologist, Sir Macdonald Stephenson, and Sir Digby Wyatt.

The first conference, as it was called, was held on March 12th, 1869, with Dr. A. Campbell in the chair. The proceedings were prefaced by a few remarks from Mr. Hyde Clarke, showing the objects of the Council in calling the Indian Committee into existence. He said—

"That they were aware that the Society of Arts had devoted itself from an early period to the promotion of Arts, Manufactures, and Commerce, not only in connection with this country, but with our colonies and with India. From time to time various subjects connected with India has been brought before this Society, and those subjects had always been received with attention ; it was natural, therefore, that those gentlemen who were specially interested in such matters, should apply to the Society of Arts to appoint a committee with a view to the holding of discussions on various Indian questions, because these subjects came within its domain, and it was equally natural that the Council, in its desire to promote a public

object of great importance, should accede to the request. It was under these circumstances these meetings had been projected. It had been the desire of the India Committee that these meetings should be in the nature of conferences, in order to elicit a greater variety of opinion, the subject to be considered being introduced by a short paper. He might congratulate them upon the presence this evening of many gentlemen greatly interested in India."

A paper on "Tea Cultivation" was then read by Mr. Fielder, the Secretary of the Tea Association, who gave its history from the first discovery of the tea plant in Assam by Dr. Bruce (to whom this Society gave its gold medal), through the period of its early fostering by Government, who, after four or five years pioneer work, made over their experimental gardens, in 1840, to the Assam Tea Company, up to the date of the lecture, a period of thirty years, when the export of Indian tea was something over 8 million lbs. It is now about 212 million lbs.

In June, 1869, the Committee reported that they had held six conferences, with four additional meetings for adjourned discussions, and made various suggestions to the Council, including the offer of a medal for the best essay on tea cultivation, and that the Council should move the Government of India to establish a department of agriculture, with the object of diffusing information and encouraging the production and amelioration of various agricultural staples. They added that, in view of the success that had attended the first year's conferences, and the number of important subjects still demanding their attention, they recommended the continuance of the Committee's action. This latter suggestion was acceded to, and I gather from an allusion made to the subject in the annual address of the Chairman (Lord Henry Lennox), delivered in November, 1869, that the advice of the Committee on the former subject was also adopted. He said that "one result of these conferences was that a deputation waited on the Duke of Argyll, and pressed on his Grace the importance of developing the agricultural resources of India by the appointment of a Minister of Agriculture, and by extending the system of assisted exhibitions of agricultural produce in India. The Duke of Argyll received the deputation with great cordiality, &c." It was shortly after this—*post hoc*, if not *propter hoc*—that the Agricultural Department of the Government of India was formed — a department which, after a starved infancy, owing both to want of means as well as want of knowledge, has of late years done much useful work, but only recently under Lord Curzon's administration has received a fairly efficient scientific equipment and may be expected to do much more in the future than it has done in the past.

How the Indian Committee of these early years came to blossom into the Indian Section is not on record, but in 1874 when other "Sections" of the Society were formed the name of Indian Section was substituted for that of Indian Committee.

Passing over a succession of years of useful work I come to some noteworthy proposals made in 1875 bearing on the use and functions of the Indian Section.

On January 29th, 1875, Sir G. Campbell delivered a remarkable address to the Indian Section of the Society of Arts at the opening of the Session. Sir George Campbell had recently returned from the post of Lieut.-Governor of Bengal. He was a man whose really remarkable ability and mental energy were lost sight of and rendered useless by his habit of addressing the House of Commons on every subject that came under discussion whether within or without the scope of his experience or knowledge. Nature, moreover, while endowing him with this inordinate love of speaking, had at the same time handicapped him with a voice and manner which rendered the task of listening to him singularly irritating, so that as a member of the House of Commons his reputation was not what his friends would have wished. Yet he was a man of real intellectual power, with a passion for absorbing information, had written several good books about India, and as Lieutenant-Governor of Bengal gave a progressive impulse to the Government of that province, which, if it rather disturbed for the time the conservative traditions of his colleagues and subordinates, has proved the fruitful parent of most of the larger reforms worked out in subsequent administrations. Returning from his work as Lieutenant-Governor, he was full of the difficulties and obstacles that had lain in the way of the reforms and improvements he was in a hurry to introduce. He explained that whereas in England all improvements in Arts, Manufactures, and Commerce came from private enterprise; in India, it was necessary that the Government should lend a hand in starting such improvements, but that in trying to introduce any technical teaching, he had found that there was no machinery. Government officials had not the requisite knowledge of the subject,

and English experts had not the requisite knowledge of Indian conditions, nor had he, as Lieutenant-Governor, a sufficient backing of public interest to overcome the *vis inertiæ* of the administrative machine. He thought he might find in the Indian Section of this Society, the machinery by which, to some extent, the necessary knowledge might be imparted, and the requisite motive power might be obtained to remove or minimise these difficulties.

"It seems clear," he said, "that there is room for great effort and great improvement, and for that improvement I think the Government of India must very much rely upon the aid of a Society constituted as this Society is—a Society devoted, I think I may say, to material as distinguished from moral and legal improvement, a Society which has taken upon itself to advance material improvement in all its branches of Arts, Manufactures, and Commerce, and which has been good enough to establish an Indian Section, in the hope that by its means a great deal may be done in regard to the progress of India.

"An immense field lies before the Society in this respect, and I think it offers a theatre in which real improvement may be practically developed to a very great extent. We know that in this country there are a very large number of practical men interested in India from a commercial and industrial point of view. On the other hand, there are resident in this country a large number of men thoroughly experienced in Indian administration; men possessing a great deal of leisure, a great deal of knowledge, and a great deal of practical experience and influence; and I believe that the function of this Society is to bring together these old Indians, and the commercial and industrial representatives of this country, in order that they may work together for the material improvement of that great country, which has been committed to our hands, and in which we have so great an interest."

Accordingly, he laid before the Society a portentous list of subjects for discussion, enough to fill a dozen sessions. Their mere outline will give you an idea of the extent of his ambition. Agriculture generally, cattle breeding, irrigation and drainage, and the sanitation connected therewith — all these were to be considered. Cotton, jute, fibres, silk, sugar, tobacco, all these had a future before them, if this Society would only show how their cultivation and manufacture might be improved. Then we were to throw light on the best policy for dealing with waste lands and with labour for the tea districts. We were to develop forestry, rubber, and cinchona plantations. Indigo (alas for human foresight!) was the one crop in which he thought Europeans had made a permanent success in India, and he was jubilant over it at the very time when friends of the planters were trying to induce them to combine for the introduction of scientific teaching both for the growth and manufacture of it. Now that it is too late this is being done and the Government are assisting liberally; had it been tried thirty years ago a great industry, and one of no less political than commercial value, might have avoided ruin. From vegetable products he turned to minerals. Iron and coal were found together. There should be a great iron industry in India. In their arts we might at least improve not the design but the material of Indian pottery. In their manufactures the Indians were already learning their lesson and setting up mills to compete ultimately with those of Manchester and Dundee. Finally, the Society should consider the needs of India in regard to communications, railways (the controversy between the broad gauge and metre gauge was in his mind), roads, lighthouses and harbours.

Sir G. Campbell was more explicit in finding subjects for discussion than in explaining how such discussion would influence the Government of India and assist in bringing about the reforms which he advocated, though in the passage I have already quoted he shows that the combination of Indian experience with scientific and commercial eminence to be found among the members of this Society would not fail to exert a beneficial influence when brought to bear on the Government and the public. At the end of his address he makes a more explicit recommendation.

"I do hope," he says, "That not only we may bring together much experience in this room for the great benefit of both countries, but I also believe it is quite possible, by developing these subjects and creating an interest in them here, you may create a corresponding interest in India also. I know of no problem in respect to India which is more interesting than that of turning into a useful channel the immense amount of education and development that we are now bringing out amongst the native classes of India. We are at this moment educating very highly large numbers of young men of the most intelligent classes in India. . . . You must turn that education into useful material channels; and amongst these young men themselves and amongst the native population I think there is a very considerable disposition to accept this view—that it is absoluteiy necessary that a large proportion ot their educated men should learn to rival Europeans, not only in respect to intellect, but in respect to practical art; and I do hope that if these subjects are earnestly taken up by this Society, we shall find that

we shall have in the great towns in India affiliated societies which will take them up on that side of the water also, which will correspond with us and learn from us, and that so working together the societies in India and this parent Society in this country may really effect very material improvement, both directly in the condition of the people in India, and indirectly by affording a field in which the education which we are now supplying to the natives may be turned into a useful channel."

Here we have a definite suggestion for extending the utility of the Indian Section, by having affiliated branches of the Society in India, and though this part of Sir G. Campbell's programme has never been carried out, and is to my mind of doubtful utility, the idea has been worked, not unsuccessfully, elsewhere. In other respects, I may say that the methods laid down in the early days of the Committee's existence, and even Sir George Campbell's extensive programme have been followed with conscientious fidelity, and have led to some evolutionary development. I have been making an analysis of the papers read before the Indian Section from the beginning, and without inflicting on you the whole of it, I may mention that seven of them deal with the tea industry; silk and cotton, and other fibres, claim twelve. Sir G. Campbell's optimistic views about indigo seem to have pervaded the Section, for I only find one paper devoted to it, and that when the ruin of the once flourishing industry was already well nigh accomplished. Railways have had no less than fourteen meetings given up to them, and a similar number have been devoted to agriculture, though this question has been dealt with more often from the revenue side than in a purely scientific aspect. The manufactures, the mineral resources, the external commerce, the currency of India and its irrigation have all received an equivalent share of attention, each subject having occupied the attention of the Section for eight evenings. But, as I have said, there has been much fresh ground broken up besides and beyond that originally contemplated by the committee. Some of the most iuteresting papers read before the Section have been those on the wilder tribes within or contiguous to the Indian frontier. Of these we have had sixteen and a similar number dealing with Afghanistan and Persia. Lately, moreover, the committee of the section have endeavoured, with considerable success, to provide a series of papers dealing in turn with each province and presidency town. Of these there have been twelve given, and I hope the series will be rendered complete. Other subjects have engaged much attention. Famines, the census, domestic life, architecture, sanitation, all these have been considered, and treated with more or less adequacy, and a vast amount of valuable information on them made available to the public. I should have expected the subject of education to have attracted more attention, especially that of female education, where the Society might have given valuable assistance, but in all I find only three evenings devoted to it. In addition to what I have enumerated above there have of course been a number of single papers upon special subjects, some of them such as Dr. Grierson's brilliant paper on the linguistic survey of India, of the highest possible value but not coming under any of the above categories. Then the question arises not only as to the quantity but as to the quality of these papers. We want to know who are the teachers as well as what are the subjects taught. Well, with very few exceptions, I may say that the writers of these papers have been acknowledged experts on the subjects treated of and in many cases the leading experts. The early years give us papers by such honoured names as Sir Arthur Cotton, Sir Bartle Frere, Sir George Birdwood (why does he no longer assist us with his papers ?), Sir Joseph Fayrer, Professor Vambery, Sir Richard Temple, Sir Caspar Purdon Clarke, Dr. Leitner, and many others. In later days, we have the "Economic Resources of India" dealt with by Sir G. Watt, the author of the "Economic Dictionary of India." We have the late Sir William Hunter lecturing on the "Religions of India." Forests are dealt with by Dr. Schlich; Burmah, by ("Shway Yeo") Sir J. G. Scott; Kafristan, by Sir G. Robertson Scott; Seistan, by Sir Henry Macmahon; Chitral, by Sir F. Younghusband—all these, at the time, were the recognised leading authorities on these special subjects. The same may be said of the papers given us by Sir Frederic Goldsmid, Sir Thomas Holdich and Major Molesworth Sykes on subjects connected with Persia. In regard to less specialised subjects, I need not remind you of the many brilliant papers we have had from the present Chairman of the Indian Section, Sir William Lee-Warner, from Sir C. Elliott, Sir Athelstane Baines, and many others. I should like to name very many more, but I think I have proved my point that these papers,

dealing with Indian subjects, and specially calculated to direct attention to them, and impart information concerning them, are the work, not of casual or ill-informed persons desirous of notoriety, or with axes of their own to grind, but of the men recognised in their own walks of life, as being the most solidly informed, and the most worth listening to on their own special subjects. Then the next question to be asked is, How far have these papers excited public interest and attained the object with which the Section was instituted? To this question it is obvious that a direct reply can hardly be given. We can only gather indications of the importance which may be attached to them outside. I think I may say from my own experience that they attract as large and influential audiences as those ordinarily attending the meetings of other sections of the Society, and that they are followed by discussions which display vivid interest and creditable knowledge, and which are almost always closured by the time limit and not brought to an end from exhaustion. Then as another test, let us see who are the people willing to come and preside at them. We have had as chairmen during the years of my own connection with the Committee (to go no further back), Lord Roberts, the late Lord Northbrook, Lord Elgin, Lord Curzon (three times), Lord G. Hamilton (on six occasions) Earl Spencer, Lord James of Hereford, the late Lord Russell, of Killowen, Mr. Brodrick, and the late Sir Henry Stanley. These are not men who would have cared to lend their time and support to wholly useless or even trivial meetings. Then we may ask, have we a hearing among our Indian fellow-subjects? Well, at different times, six of them — the earliest, Mr. Dadabhai Naorojee (in 1871), Professor J. C. Bose (in 1897), and the latest Mr. Wagle (in 1902)—have themselves occupied the platform, and we are promised, I am glad to say, another paper in December by a Mahommedan gentleman, Mr. Yusuf Ali. Among the members of the Society, there are some 250 residing in India, of whom half probably are Europeans. But among Indian names we have the Maharajas of Jodhpore, of Travencore, of Bhawnagur, of Kuch Behar, of Burdwan, and of Bobili. Indian commerce, too, is very strongly represented—and among retired Anglo-Indians we have enough ex-Viceroys, Governors, Lieutenant - Governors, Members of Council, &c., to furnish a complete, if somewhat mixed, administration—at all events, we have enough here to show that the proceedings of the Section are not without interest, and if occasion required, might not be without influence.

I should not like to let this opportunity go by without saying publicly how much the Indian Section is indebted for its success in recent years to the work of its able and energetic Secretary, Mr. Digby, especially in the matter of obtaining (by peaceful persuasion!) the admirable papers to which I have alluded from our modest or unenterprising contributors, and then bringing them to the notice of all persons likely to be interested; and it is in our large and attentive audiences that he finds his work has not been in vain.

I have often given consideration to the question how—outside the slow process of educating public opinion by papers and discussions, the process of infiltration which is always going on—the Indian Section of this Society may be further developed and made more fruitful, but I cannot say that I have any useful suggestion to offer. I have shown that in early days gone by the Society used to bring direct pressure to bear on the Government by means of deputations and correspondence. I can imagine that in exceptional circumstances it would still be possible to adopt such a course, and a sufficient array of influential names both commercial and official might be collected to justify it. But the circumstances would have to be very exceptional, and we must never forget that as a rule this Society rigidly eschews party politics, and day by day every subject on which we might wish to influence the Government tends more and more to become a question of party politics. Apart from this method of acquiring influence, the only suggestion I have seen is that of having affiliated branches of the Society in India. The subject is worth considering, and might well be made the subject of a paper at some future meeting of the Society. Personally I see little to be gained by it, and serious pitfalls in the way of it, and I should hesitate to advocate it. Then it is to be noticed that there are other societies whose aims and objects are to some extent identical with, or at least overlap, those of the Indian Section. Now the history of the Society of Arts, as has been shown in the Address of one of its recent Chairmen, has been that of fissiparous reproduction, that is to say, different sections having grown to maturity, have broken off from the parent society and formed separate specialised asso-

ciations. It may ultimately be the fate of the Indian Section to do this, and amalgamate with other similar societies, into one large Indian association, but, at present, I see no probability of this—the time for it, if it ever comes, is not yet. The Indian Section has neither the wish nor the capacity to set up house on its own account, and break off from the parent society—and I only mention the suggestion to discountenance it. But, on the other hand, I should welcome a time when the Indian Section of the Society of Arts might absorb the other societies; when, in a building with ample accommodation, the Section might be allowed its own office, library and meeting-room, as a centre of information on Indian subjects. But, perhaps, this, too, is for the present, Utopian.

On the whole then, reviewing the past, I think the Indian Section has had a fairly useful and successful life, and I can suggest nothing better than to go on as we are going, *super antiquas vias*, and let time bring its own development. Even as it is the man who has studied the weekly *Journal* of the Society of Arts has provided himself with a liberal education. In this way we may augur for it a long life of continued and increasing usefulness.

I have referred in the earlier part of my Address to the by-law which makes it incumbent on the Chairman to refer to the lines on which the Council propose to carry on work during the ensuing session. A few words, therefore, on our prospects may not be deemed inappropriate.

The list of papers to be read at the Ordinary Meetings is a very full one, and I think promises as interesting session as any we have had. There will be four meetings before Christmas, at the first of which Mr. J. W. Gordon is to read a paper on "Patent Law Reform," a subject which has always been of the greatest interest to the Society. Another topic which has often been dealt with in this room will be treated by Sir Charles Watson on the following Wednesday, namely, "The Metric System." Most previous papers have been in advocacy of the system, but I understand that Sir Charles Watson will deal principally with the practical objections to its introduction. The results of the over-protection of birds on the fruit-growing industry has been a cause of frequent complaints this summer, and this topic will be treated by Mr. Cecil Hooper, who is himself interested as a practical fruit-grower. At the other meeting before Christmas the President of the Association of Millers, Mr. Albert Humphries, will tell us something about recent improvements in Flour Milling and the production of Bread.

We have already a number of papers arranged for the meetings after Christmas, one of which on the Panama Canal is of special interest, because the author is the distinguished French engineer who was formerly in control of the work, Monsieur Bunau-Varilla. Lord Montagu, of Beaulieu, has, I am glad to say, promised us a paper on "Motor Omnibuses," which certainly ought to lead to a good discussion. Another paper likely to be of value is one by Mr. E. Young on "Life Insurance," and there are also many others of considerable interest.

There will be one meeting of the Indian Section before Christmas, at which a paper is to be read by Mr. A. Yusuf Ali on the "Indian Mohammedans," and one also of the Colonial Section, when Sir Lewis Michell will discuss "The Cape to Cairo Railway." In the Applied Art Section, Mr. Thomas Okey will describe the history and art of "Basket Making."

Other papers promised or in contemplation for the Indian Section are on the practical working of famine relief—personal reminiscences by Sir Frederic Lely, lately Chief Commissioner of the Central Provinces; a paper on the City of Madras, in pursuance of the series to which I have already alluded, by Sir James Thomson, late Member of the Madras Council; one on the "Irrigation Colonies of Sind and the Punjab," and one on the employment in India of the Italian method of utilising river silt for the production of fertile land, by Sir Edward Buck.

In the Colonial Section we hope to have papers after Christmas on "The Progress of the Uganda Protectorate," by Mr. G. Wilson, C.B., Deputy Commissioner; "on British Malaya," by Sir W. H. Treacher, and on "Rubber Cultivation in the British Empire," by a well-known expert.

In the Applied Art Section after Christmas, papers are promised on the "Artistic Treatment of the Exterior of the Pianoforte," by Mr. William Dale, and on "Joinery and Cabinet Making," by Mr. A. Romney Green. Mr. A. P. Laurie, Principal of the Heriot Watt College, Edinburgh, will continue the discussion of the important subject of the Materials used in the painting of pictures, which Professor John M. Thomson treated last session in his paper on the "Chemistry of Artists' Colours." Mr. Laurie will deal with

"Oils, Varnishes, and Mediums." Mr. Sherard Cowper-Coles will contribute a paper on "Sheffield and Electro-plate."

The Cantor Lectures, I am glad to think, are well up to the standard of these valuable communications. Mr. A. D. Hall has already commenced his course on "Artificial Fertilisers." You know how much attention has been drawn of late to this subject. Sir William Crookes prophecies the ultimate failure of our wheat crops if we are obliged to depend for the supply of nitrates which the soil requires on existing sources, and says the only hope of the agriculturist is in the fixation of nitrogen from the atmosphere. That the fixation of atmospheric nitrogen on a commercial scale is possible has been shown by more than one inventor, but whether or no it can be produced at a sufficiently low cost yet remains to be demonstrated. The courses after Christmas will deal with Gold Mining, Romanesque Ornament, and the Materials used in Laundry Work—a sufficiently varied list.

One word more. I have hinted in dealing with the future of the Indian Section that we are somewhat cramped for space. For the past two years, the Council were not without hopes that the Society might have received a great extension by becoming amalgamated with the London Institution, and that a new Society might have been established to carry on the work of these ancient Institutions with renewed vigour. As you are aware, the efforts made in this direction have come to nothing. But the Council are now endeavouring to ascertain whether additional accommodation cannot be provided for the Society on the site it has so long occupied, by the acquisition of adjacent premises. Whether this can be successfully accomplished, and on terms which the Society can afford, is a question which is now engaging their very careful attention, and should their endeavours be successful, I have no doubt that the Indian Section no less than the Society at large will be greatly benefited.

After delivering the Address the Chairman presented the Society's medals which were awarded for papers read during last Session.

At the Ordinary Meetings :—

To Mr. W. F. MITCHELL, for his paper on "The Commerce and Industries of Japan."

To Dr. WILLIAM ARTHUR AIKIN, for his paper on "The Scientific Aspects of Voice Development."

To Mr. LEON GASTER, A.M.I.E.E., for his paper on "Progress in Electric Lighting."

To Mr. WALTER GARSTANG, M.A., for his paper on "The Fisheries of the North Sea and the Bearings of Recent Investigations upon the Problems of Supply."

To CAPTAIN G. S. C. SWINTON, for his paper on "London Traffic."

To Mr. BERNARD B. REDWOOD, B.A., for his paper on "Motor Boats."

To Mr. J. B. MILLET, for his paper on "Submarine Signalling."

To PROFESSOR THOMAS OLIVER, M.A., M.D., LL.D., for his paper on "Bridge Building by means of Caissons, including remarks upon Compressed Air Illness."

To Mr. CLAYTON BEADLE, for his paper on "The Development of Watermarking in Hand-made and Machine-made Papers."

In the Indian Section :—

To SIR JAMES A. BOURDILLON, K.C.S.I., for his paper on "The Partition of Bengal."

To DR. GEORGE A. GRIERSON, C.I.E., Ph.D., D.Lit., for his paper on "The Languages of India and the Linguistic Survey."

To COLONEL SIR ARTHUR HENRY MCMAHON, K.C.I.E., C.S.I., late British Commissioner, Seistan Arbitration Commission, for his paper on "Seistan: Past and Present."

In the Colonial Section :—

To THE HON. RODOLPHE LEMIEUX, K.C., M.P., for his paper on "Glimpses of French Canada."

To THE HON. J. G. JENKINS, Agent-General for South Australia, for his paper on "Social Conditions in Australia."

In the Applied Art Section :—

To Mr. LOUIS N. PARKER, for his paper on "Historical Pageants."

To Mr. H. YATES THOMPSON, F.S.A., for his paper on "Some Illuminated Manuscripts of Continental Europe."

To Mr. HARRY POWELL, for his paper on "Cut Glass."

SIR MARCUS SAMUEL, Bart., in proposing a hearty vote of thanks to the Chairman for his excellent address, said the qualifications for the position which Sir Steuart held were very numerous, requiring a knowledge spread over a great variety of subjects, but the Chairman had shown that he possessed them all. He had shown in his address the excellent work the Society was performing in encouraging the expression of opinions on divers subjects, and formulating the very best ideals that could be given in the very large field which lay before the Society.

Sir OWEN ROBERTS, in seconding the motion, said the Chairman had delivered a very excellent sermon. If all sermons were like his, illumined by his humour and his delightful cynicism, he thought the percentage of those who attended church on Sundays (which, he regretted to hear, was only about 18 per cent. of the population) would be greatly increased. He anticipated an exceedingly successful year for the Society under the chairmanship of Sir Steuart, and thought he interpreted the feelings of all present when he said they had spent a delightful evening in listening to a most valuable sermon.

The resolution of thanks was put to the meeting by Sir MARCUS SAMUEL and carried unanimously.

The CHAIRMAN, in reply, thanked the mover and seconder of the resolution for the exceedingly kind words they had used in proposing it, and the audience for the hearty manner in which they had received it. He could only echo Sir Owen Roberts's wish that his year of chairmanship would be a successful one.

THE FRANCO-BRITISH EXHIBITION.

The proposal to hold an exhibition confined to the arts, manufactures, and products of France and the United Kingdom has been received with marked approval on both sides of the Channel. Such an exhibition will be welcome for two reasons. In the first place it will materialise the good feeling which now exists amongst the people of both nations; in the second, it will have the tendency to increase the volume of trade between the two countries. Our commerce with France is already larger than with any other country in the world excepting the United States, and it is capable of considerable increase while it is complementary and not competitive, inasmuch as the products and manufactures of both countries are almost entirely dissimilar.

The suggestion to hold a Franco-British Exhibition was first made in the latter part of 1905 by the French Chamber of Commerce in London, and was brought under the notice of the French Government through M. Cambon, their Ambassador to London. The French Minister of Commerce, M. Doumergue, strongly approved of the proposal, and it was warmly supported by the Comité Français des Expositions à l'Etranger, a co-operative association which acts as the official representative of French industry at all exhibitions outside France in which the Government takes part. The Exhibition was launched at a great meeting held at the Mansion House on July 11, 1906, at which the Lord Mayor presided. The Duke of Argyll, Honorary President of the Exhibition, explained the proceedings of the noblemen and gentlemen who were associated with the project, and resolutions were unanimously agreed to approving the proposal to have a Franco-British Exhibition in 1908, and the proceedings of the committee, authorising the appointment of the necessary committees and the institution of a guarantee fund. It was likewise decided that any profits accruing from the exhibition should be devoted to some public purpose, the exact nature to be determined by the British and French committees.

The organising committee had already entered into arrangements for holding the exhibition on grounds 98 acres in extent at Shepherd's Bush, near the terminus of the Central London Railway, popularly known as the Tube. The locality is admirably adapted for the purpose to which it is proposed to put it, being in immediate proximity to half a dozen railway stations, and in the centre of a perfect network of tramways and omnibuses which connect Shepherd's Bush with all parts of the metropolis and suburbs. The site has been inspected and warmly approved by the French Committee.

In response to a telegram from the Lord Mayor to the President of the French Republic, announcing the success of the Mansion House meeting, a reply was received, through the French Ambassador, to the effect that the French Government would not fail to give its cordial support to the exhibition. Subsequently, at a dinner given in Paris in October by the French Committee to the Lord Mayor, the French Minister of Commerce stated that the French Government had identified itself with the Exhibition.

The project has been received with equal enthusiasm by France and the United Kingdom. At a dinner given by the Fishmongers' Company, in October last, in honour of the exhibition, the Prime Warden expressed his opinion that it would have an excellent effect in further cementing the interests of the two nations, and the British Empire League, at a meeting held on the same day, in the House of Commons, resolved unanimously, on the motion of Viscount Selby, the former Speaker, to give its support to the exhibition, and invited its members to do all in their power to ensure its success. The general committee now numbers more than a thousand persons, including the Duke of Argyll (the honorary president), the Earl of Derby (president), the Lord Mayor of London, a large proportion of the Peers and Members of the House of Commons, nearly all of the Lord Mayors, Lord Provosts, Mayors and Provosts of the great cities and towns of the United Kingdom, the Presidents of their Chambers of Commerce, and he most prominent members of the worlds of finance, commerce, and railways.

The entrance to the exhibition will be adjoining the terminus of the Central London Railway, and the visitor, on entering, will at once find himself surrounded by objects of the greatest interest. The demands for space are already so large that it has been found necessary to supplement the original 98 acres by an adjoining 42 acres, making altogether

140 acres. The grounds will be surrounded by an automobile track, one and a-half miles long, which will be the best and safest in England, and will afford to all persons interested in automobiles, either as owners or manufacturers, an opportunity of testing their cars, and will enable motor races to be run without any danger to life or limb. On the north-eastern portion of the grounds a large area has been set aside for sport. There will be tracks for cycles and athletics, which will surround a considerable space devoted to such games as cricket, football, lacrosse, and lawn tennis. This block of land, in addition to another of greater extent in the north-west intended for amusements and attractions, are contiguous to, but apart from, the grounds devoted to the exhibition proper. The largest building, that devoted to machinery, will contain 321,066 square feet and will be the most considerable one devoted to that purpose in this country. Other important palaces and halls will be the fine arts palace, the new industrial hall, the agricultural hall, the palace of music, the education building, the hall of science, the applied arts hall, and the halls for processes and manufactures. All these structures will be absolutely fire-proof. The material employed in their construction is steel, concrete, and composition stone.

Favourable arrangements have been made with the railways and steamboats, English and French, which connect the British with the French metropolis, and it is confidently expected that passengers from Paris will be able to go direct to the exhibition without change of carriage from the seaport at which they landed, and a committee is being organised to look after the comfort of all visitors from abroad or from the provinces, so that they may be able to visit London and inspect the contents of the exhibition buildings at the minimum of cost, and with the maximum of convenience.

A novel feature will be introduced in the shape of commercial bureaus. A visitor, on entering the exhibition, will be able to discover at once the exact locality of anything which he specially wishes to see, and also to obtain any literature and information about it which may be published. Should he desire to be brought into immediate contact with the artist, manufacturer, or producer, facilities will be given him for carrying out his wishes. There will be branch bureaus in the different buildings so that all persons, whether on business or pleasure, will be able to see what they desire to see with the smallest fatigue.

The restaurants, cafés, and refreshment rooms will be under the management of some of the most famous caterers in France and the United Kingdom, and will be under the control and supervision of the executive committee, who will arrange that the prices inside the exhibition shall not exceed that usually charged in Paris and London for similar articles outside.

The executive have secured the co-operation in the organisation and administration of the exhibition of Mr. Imre Kiralfy, whose experience in such matters is very great.

THE TRADE OF INDIA, 1905-06.

I.

The annual Review of the Trade of India during the year ended 31st March last possesses some interesting features of novelty, for which, doubtless, readers are indebted to its author, Mr. F. Noel-Paton, Director-General of Commercial Intelligence. For instance, the Review opens with a general synopsis of the climatic conditions of the year, which shows very strikingly how dissimilar are the physical conditions prevailing in the various provinces, and how floods, droughts, frosts, and hailstorms operate with an intensity and force unknown in temperate climates. The frontier trade, too, is analysed in much clearer fashion than heretofore.

The grand total of imports and exports of Indian trade declined by 1 per cent., or by 3 crores of rupees (= 2 millions sterling) as compared with the trade of 1904-5. The decline was due to the contraction in the imports of treasure, which in the case of gold receded by 7 crores, principally owing to the strong demand for the metal in Japan and America. Omitting, however, the imports and exports of treasure, the grand total trade (merchandise only) advanced a further 4·2 per cent., imports having risen 6·6 per cent., and exports 2·7 per cent.

Imports of Indian Merchandise.

During the last quarter of a century Indian import trade has more than doubled in value. Among the articles of food and drink, which constitute an important and generally thriving group of this trade, more than half of the total value is represented by sugar. In regard to this produce, the fluctuations in prices have been considerable. The previous year 1903-4 had been marked by the highest price recorded in Bombay of recent years. This was due to several causes. The abolition of the bounties in European producing countries and the consequent reduction of the internal sugar taxes had led to a restriction of cultivation and to an unforeseen expansion of domestic consumption. But as these high prices induced an increase of some 16 per cent. in the acreage sown with beet in Europe, and the utilisation of reserve stocks, a speedy fall in prices soon set in, and prevailed during the greater part of the year 1905-6. As to the countries which send sugar to India, Java, which headed the list last year, has now given place to Austria-Hungary, Mauritius being second. With regard to salt, another product of importance, it is noteworthy that the successive reductions of salt duty have been attended by a growth in consumption. In 1905-6, however, there was a decline of about 4·3 per cent., due in great part to the political boycott of foreign goods. Liquors, which

are divided into three groups, malt liquors, spirits, and wines, showed a substantial progress in 1905-6. In respect of beer, there was a general resort to the lighter and cheaper descriptions, with the consequence that Germany and other foregn countries are slightly gaining on the position of the United Kingdom as a source of supply. The out-turn of Indian breweries appears to be diminishing slightly year by year, but it still keeps ahead in point of quantity with the five million odd gallons imported. As regards spirits, the amounts issued from Indian distilleries are largely in excess of the imports, *i.e.*, about 8¾ million gallons as compared with 1⅝ million. Since February last, the rates of import duty on spirits have been raised, the object being to place imported spirits on a par with native spirits in the matter of taxation. For some years there has been steady decline in the value of wines imported but, in 1905-6, there was a substantial recovery of some 7·1 per cent. in quantity, and 13·6 per cent. in value, the converse in the decline in average value noticed in beer. The imports of foreign tea—which includes tea from Ceylon—remain fairly constant. The quantity rose slightly, with a decline of value, this being due to the fact that the more expensive tea from China is being more and more displaced by cheaper tea from Ceylon.

Coming now to the important group, entitled "Metals and Manufactures of Metals," which includes cutlery, agricultural implements, enamelled ironware, and sewing machines, we note that the aggregate value declined by about 45 per cent., of which the share of the United Kingdom was about one lakh of rupees. Germany, on the other hand, marked an absolute increase of about the same amount, but as the figures for Belgium and Germany are very closely interwoven, the exact share of each is uncertain. The two countries together are progressing steadily. The most notable declines are in Austria-Hungary, a country which used to be supreme in enamelled ware, but whose share has receded from 62 to 40 per cent., while Germany has advanced her's from 31 per cent. to 54 per cent. Metals continued to be imported in greater quantities, 504,160 tons in 1904-5, having risen to 549,863 tons in 1905-6. The total value declined, however, owing to the cheapening of the metals most largely used and the restriction in the imports of some costly metals like copper. The last-named shows an even more marked decline than it did in 1904-5, amounting to 36·5 per cent. in quantity and 32 per cent. in value. The general contraction is a phenomenon of the extraordinarily high level of copper prices throughout the world, the marked activity of the engineering industries having carried prices to an extreme level.

In regard to imports of iron and steel, the year 1905-6 was one of exceptional activity and improved prices. The revival was first felt in America, where business generally has been extraordinarily prosperous, and after midsummer it gradually took effect in the United Kingdom and in India, where the development of the engineering industries and the increase in shipbuilding intensified demand. In regard to iron, the value of the imports was less than in 1904-5, but in the imports of steel there was an increase of 34·7 per cent., this being in accord with the general trend of trade throughout the world. While the United Kingdom improved her position in respect of steel alone, Germany and Belgium registered an advance in both iron and steel. The tin plate trade fell away five per cent. to a value of nearly 37 lakhs of rupees, having been subject to a good many disturbing influences in the past year. On the one hand a great rise in the price of tin itself took place, and on the other hand there was enormously increased production of plates with accumulation of stocks. Imports of lead rose slightly in 1905-6; while tin, like copper with which it is often associated in manufacturing processes, declined to the extent of 46 per cent. in quantity, and 37·5 per cent. in value.

The continuous growth in the importation of machinery is one of the most healthy features of Indian trade, and has been remarkable in 1905-6. The previous year had constituted a record, with imports valued at 402·7 lakhs of rupees, but this total was exceeded last year by 22·2 per cent., bringing the total value up to 491 lakhs. The year has been exceptional, especially in respect of the great activity in the textile industries, jute machinery in Bengal, and, to a less degree, cotton machinery in Bombay, having been largely imported. After textile machinery, rank steam engines and their component parts—electric, mining, and other descriptions.

In imports of railway material there has been fairly continuous expansion during the last four years, the figures for 1905-6 being 673 lakhs of rupees.

Passing by chemicals, drugs, and medicines, which present no special features of importance, we come to tobacco, where the only development observable is in the cheaper sorts of cigarettes, which showed an increase of 23·8 per cent. on the large total quantity recorded in 1904-5, and this in spite of the well-known boycotting movement in favonr of the native-made article. Ten years ago, the imported cigarette was scarcely known to the native community; now the value amounts to 45 lakhs, of which 28 lakhs came from the United Kingdom. The only class of cigarette which declined, was the better quality imported from Egypt.

Mineral oils showed a decrease of 32 per cent., confined chiefly to kerosene; more than half of the decrease was due to the destruction and anarchy in the Baku oil fields.

In the group classed as "Raw Materials," the decline in the imports of foreign coal continues, as the Indian production increases, and the import trade is now governed largely by considerations of freight obtainable on the return journey. The exports in Indian coal, it may be mentioned here, exceeded the figures for the preceding year by over 40 per cent., both in quantity and value, so it is scarcely surprising to see the imports from the United Kingdom and Japan falling off.

Silk is a product liable to great fluctuations, and, in spite of good crops in France, Hungary, and the Levant, the imports into India receded; on the other hand, average prices were higher than in 1904.

The imports of cotton declined from 192,554 to 161,476 cwts., but two years ago the quantity was only 18,279 cwts., so this need not surprise any one. Foreign cottons are used mainly for spinning counts higher than the Indian staple lends itself to, and the strong demand all through India and the East for coarse yarns enables Indian manufacturers to dispense with the imported article at the relatively high prices asked.

Precious stones and pearls, unset, as recorded in the trade accounts, bear no very close relation to the true imports, for it is known that large quantities of pearls are both imported and exported by post so as to escape record. There was a rise of nearly 53 per cent. in 1905-6, nearly half in pearls from Muscat and the Persian Gulf. There was also a large increase of jewels from the United Kingdom. The trade in timber has risen 40 per cent. during the year, following a rise of 37 per cent. in 1904-5, the greater part being due to Siamese teak, which is taking the place of Burma teak.

The very important group of cotton goods was on an unprecedented scale, and reflected the general activity of the world's textile industry, except in Russia. The aggregate value of the imports of cotton yarn and of woven and other cotton goods, was 424 millions of rupees, an increase of 11·6 per cent. In yarns, the increase of value was 37·7 per cent., but the decline in specific value was 7·99 per cent. Yarns from the United Kingdom, which represent 93·5 per cent. of the whole, increased 52 per cent., and since the British exports of yarn in 1905, showed an advance of 25·7 per cent., it may be considered that India took her full share. The imports of dyed and undyed yarns continue to be of nearly equal value.

A comparison of the imported yarn with the production of yarns from Indian mills, shows that in regard to low counts (1 to 25) the imports were quite insignificant, viz., 3 or 4 million lbs. as against 634 million produced in India; of the counts (26 to 40) there was comparative approximation, 33 million as against 45 million lbs., while of the counts above 40, the figures were 5·8 millions, and 1·1 million lbs. respectively.

The imports of cotton fabrics increased in value from 3,555 to 3,901 lakhs of rupees, representing over 37 per cent. of the total imports of private merchandise. The increase is 9·7 per cent., bringing the total increase in two years to 35 per cent. Although, during the last sixteen years, the demand for grey goods has not kept pace with the development in white and coloured goods, the former contributed by far the greater part of the increase in 1905-6. Considering the large contributions now made by the Indian mills to the supply of grey goods, their unprecedented activity in that particular line in the year under review, and the revival in the hand-loom industry (whose output is believed to be double that of the Indian cotton mills), the increase in the imports of these textiles most largely used by the poorer classes must be regarded as a mark of prosperity among the masses. It is noticeable that Bengal, where there are two cotton-weaving mills, took 74 per cent. of the total of imported grey goods in 1905-6. England's shares of the grey goods, bleached goods, and coloured goods are 99, 98, and 95 per cent. respectively. Besides these there are subsidiary goods, such as handkerchiefs and shawls, hosiery, sewing thread, and other manufactures imported. Of the first and third classes the United Kingdom supplies 88 and 85 per cent. respectively. But the considerable item of hosiery is monopolised by Japan, Italy, Germany, Austria, Belgium and Spain.

Silk manufactures, after three years of continuous progress, receded to 190 lakhs of rupees, though the average price improved slightly. In imports of woollen goods there was a reaction of some 21 per cent. in 1905-6, and the total value receded from 307 to 242 lakhs of rupees.

In a long list of "other manufactured goods," including a variety of miscellaneous items, one of the most notable increases is under the head of "Carriages and Carts," which includes motor cars and motor cycles (34,99 lakhs) and cycles (15 lakhs).

Arrangements have now been made, and will soon come into force, by which the true countries of origin will be more correctly ascertained, in the case of goods imported into India. We are nevertheless informed that for some years retrospective comparisons will have to be conducted on the basis of the old system. According to that system, the United Kingdom increased its predominance in imports from 65·2 to 66·7 per cent. The chief other countries rank as follows:—Belgium, Germany, Austria-Hungary, Straits Settlements, and the United States.

Imports of Government stores are not included in these figures. They are large, amounting to 902·7 lakhs in 1905-6, as against 773 lakhs in the previous year, and the share of the United Kingdom, though it is marked by an absolute increase in value, declined from 94 to 90 per cent. of the total. Material for State railways, forms a considerable part of this heading.

INSANITY.

The sixtieth Report of the Lunacy Commissioners shows that the total number of notified insane in England and Wales continues to increase. On the 1st of January, 1906, it stood to the estimated population in the proportion of 1 to 283, or 35·31 per 10,000 of the population, an increase of 0·62 per cent. on the ratio for last year, contrasting with an actual numerical growth of 1·79 per cent. In 1897 the ratio was 31·89, so that in the decade it increased 10·72 per cent., the proportion of insane

persons in the community rising from 1 to 314 to 1 to 283. The actual increase in the population during this period has been 10·8 per cent., and in the total number of insane under care 22·7 per cent. This does not necessarily imply, as the Report points out, a corresponding increase in insanity, but only of persons detained under care. The population of England and Wales has increased from 22,223,299 in 1869, to 34,547,016, *i.e.*, 55·4 per cent. in 1906; the total insane on the 1st January, 1869, was 53,177, on the same date in 1906 it had increased to 121,679. The admissions during the year 1869 were 10,472, during 1905 they were 21,622, an increase of 106·4 per cent., but the ratios have not increased to a like extent, being less than the increase in population. If the relative distribution of the pauper insane at the present time is contrasted with that obtaining in 1859, the first year for which there are accurate statistics for the comparison, the contrast strikingly shows to how large an extent this class is now cared for in special institutions. In making this comparison, the asylums of the Metropolitan Asylums Board, which date from 1870, are ranked. On this basis it will be found that, whereas in 1859 the proportion detained in asylums, hospitals, and licensed houses was 56·2 per cent., in 1906 it is 84·9 per cent. On the other hand, whilst in 1859 the proportion in workhouses was 25·4, it is now 10·0 per cent., or, if the metropolitan district asylums be classed with workhouses, 16 per cent.

The increase in the numbers of the insane has taken place year by year although not with equal proportions. Taking the last decade, it will be found that as between the figures for 1896 and 1906 respectively there has been a total increase of 26·5 per cent., whereas the annual increase has ranged from 1·03 in 1900-1 to 2·08 in 1903-4, receding to 1·08 in 1905 6. It is interesting to observe that the numbers annually admitted into institutions and in single care do not follow the general rates of increase, for whilst in the whole decade they increased 16·8 per cent., they had, up to 1902, increased as much as 23·4 per cent., there being during the following years an actual diminution in the proportion amounting in all to 6·6 per cent. A similar result follows a study of the figures for first admissions since 1898, for though up to 1902 the increase on the 1898 figures amounted to 22·4 per cent. (of which as much as 10·1 was in 1901-2) the total increase by 1905 had fallen to 14·7 owing to the falling off of such admissions in the past three years.

The Report touches upon the question how far the cause of an attack of insanity is related to the occupation of the patient. It is a subject worthy of careful and detailed research but the data available only permit of an approach to the fringe of it. As a contribution the Commissioners have singled out for special analysis the returns from four asylums receiving patients from communities whose pursuits are mainly agricultural, namely, Cambridge, Dorset, Wilts, and Hereford. The period dealt with is the three years 1900-2 inclusive, during which there were admitted into these asylums on an average annually 220 males and 256 females. The original causes of insanity in these cases were then compared with the average in all asylums for the five years 1899-1903 inclusive. The general result was to show that in these counties the causes which were above the mean were religious excitement, sexual decay, sunstroke, privation, old age, hereditary influence, and congenital defect, whilst those below the mean were domestic trouble, adverse circumstances, mental anxiety, fright and shock, intemperance in drink, and a few others. The statistical result bears out what may have been assumed, *à priori*, in the case of rural communities, where the lack of brain activity may conduce to the dementia that accompanies old age, intermarriage favours transmission of feeble brains and congenital deficiencies, avocations expose to risk of sunstroke, low wage earning may be responsible for privation, and revivalism in religion may be more potent in disturbing mental balance than grief or anxiety. The returns on the type of insanity exhibited by the patients admitted into institutions other than idiot establishments show that during the five years 1900-1904 inclusive, there were annually in every 100 admissions 5·4 who were subjects of congenital insanity, 40·7 cases of mania (all forms), 30·5 of melancholia (all forms), 40·1 of delusional insanity, 6·6 of general paralysis, and 12·7 of dementia (all forms). The Commissioners say they have frequently had occasion to complain that persons of distinctly unsound mind were detained, or allowed to remain, in workhouses without the requisite legal authority; and of the inadequacy of the means of escape for imbeciles in many of the houses in the event of an outbreak of fire. The Commissioners are able generally to report favourably on the ordinary workhouses visited by them during the year.

BUCHAREST EXHIBITION AND ROUMANIAN ASSOCIATION.

In commemoration of the forty years' reign of Charles I., an Exhibition is now being held at Bucharest, where the fifth Congress of the Roumanian Association of Science has also assembled during the month of October. The number of members who joined the congress amounted to 4,000, almost double the number who attended the last meeting of the British Association. Judging from the importance of the papers read and the discussions following, there is noticeable a distinct advance in the appreciation of the value of education on the part of the Roumanians.

The Congress was divided into ten sections, the best attended being the one dealing with Educational Science, comprising over 3,000 members, including university professors, and teachers of all classes. Great attention was given in this section to the

question of extending the number of hours at schools prescribed for physical training and military drill.

The Economic Science Section was also well attended, and great interest was attached to the papers read dealing with the improvement of the state of the peasantry, a subject which engages the attention of all political parties of the country. The outcome of this meeting has been the inauguration of a special society, starting with over 200 members, and having as its object the thorough investigation and discussion of the social and economical problems of Roumania.

One of the characteristic features of the Congress was the fact that, for the first time the clergy as a body, participated by forming a separate section, and among other questions discussed, the scientific aspects of religious teaching received considerable attention.

Among the other sections in which good work was done, mention may be made of the Medical, Physical, and Chemical Sections. On the whole, over 160 papers were read. The next Congress will take place September, 1907, at Focsani.

GERMAN COAL SUPPLY IN 1906.

According to a recent report by the American Consul at Munich, the coal supply from German mines, for the large industrial cities of Germany, in the first half of 1906, was not equal to the demand. The supply increased 8 per cent. from 1905 to 1906, and 12 per cent. from 1904 to 1905, although in the last-named year the trade was retarded for two months by a strike. The causes given for the short supply this year are lack of labour in mining and an insufficiency of cars for transporting the coal. This lessened increase in the supply is certainly not caused by a lessened demand, as all branches of industry have shown great progress in the first half of the current year. The twenty largest industrial cities in Germany used 8,100,827 tons of hard coal in the first half of 1906, 7,429,778 tons in the same period of 1905, and 6,618,984 tons in the first six months of 1904, showing an increase of 671,049 tons, or 8 per cent. in the current year, and of 810,794 tons, or 12 per cent., last year. The supply in the first quarter of the present year was even smaller in quantity than in the same period of last year, which may, however, be explained by the fact that most consumers and speculators laid in large stocks last year to provide against the threatened strike. The supply to the largest industrial cities in Germany for the first six months of the present year was as follows:—Berlin, 2,541,704 tons; Leipzic, 900,190; Cologne, 770,763; Dresden, 530,668; Frankfort, 424,774; Magdeburg, 345,404; Munich, 340,606; Altona, 276,746; Barmen, 266,391; Nuremburg, 202,135; and Halle, 177,068 tons.

ARTS AND CRAFTS.

Writing and Illumination.—When once the printing press was firmly established the art of beautiful writing began to die out. It is true that in the sixteenth century some beautiful writing books were produced, but after that, although books about writing did from time to time appear, they were by people who looked upon the art from the point of view of the writing master, not of the scribe. They taught the would-be learner how to cultivate perhaps a delicate Italian hand, or to make flourishes worthy to adorn an address, or to ornament the beginning of a legal document; but their authors would have been astonished—not to say shocked—at the suggestion that this writing of theirs should be used in the same way as that of the professional scribes who spent their lives in writing in the days when printing was not. When, in comparatively recent years, the typewriter (with its usually quite unnecessarily ugly type) had gained a firm footing on the market, it seemed that the last hope of getting people to write even good, legible, every-day hands was gone. The illuminated addresses, too, of a period within the memory of most of us were so ostentatiously ugly that they seemed past praying for. And yet, even when things were apparently at their worst, something was being done. Opposing schools are very much inclined to overestimate, or to underestimate, as the case may be, the artistic work of William Morris, but there can be little doubt that he was interested in writing long before the art was receiving any public attention, and that the exhibition, a few years ago, of some of the books which this most impatient of men had so patiently written and illuminated was really the starting point of the popularity which writing now enjoys with a certain section of the community. And, though Morris's writing is not the model of that which is being so largely taught and so diligently practiced at the present day, this is not by any means unallied to it.

Script.—The writing which is so much in vogue to-day is of rather too laborious a kind for the purposes of every-day life. Indeed, it is rather surprising that in this bustling, hurrying, commercial twentieth century it should ever have come into fashion at all; but it has done so, and with a truly amazing rapidity. Ten years ago it wonld not have occurred to anyone to show a page of manuscript at any exhibition; to-day pages or books of "script," as it is usually called, form a feature of every show which takes to itself the name of Arts and Crafts. Some of the work is in Roman capitals, but the form of letter usually adopted is the uncial or half uncial. Apparently all the writers have founded themselves on these models, and very few of them have the individual character which would make it easy to distinguish readily the work of one writer from that of another. This explains itself when we realise that, though the subject is taught in many schools to-day,

the teachers are practically all of one school—trained at the Central School of Arts and Crafts, where the study was apparently introduced, not more than seven years ago. Within these last few years not only has the art attracted a good deal of attention, but it has really become quite the rage, and it creates no more surprise now to learn that an amateur is taking lessons in script than it would have done some years back to be told that he (or she) had taken to poker work. One feels, indeed, that the ample space devoted to writing in Mr. Edward Johnston's recent book is no more than the exigencies of the moment demand, and it is satisfactory that his most practical and useful information has appeared at a time when so many people are likely to profit by it. So far as the fashion has produced a class of scribes who can on occasion write legibly and prettily, and with a due appreciation of the proportions of the page, it has really done good service. Moreover, the re-introduction of a good standard of writing has made those responsible for addresses, testimonials, &c., take more care to get a fairly well executed piece of work —or perhaps it would be more accurate to say that since they have not had so far to go in search of good work, they manage to get a better type of writing than that which would have contented them say twenty years ago. Still one rather wonders why the art is so popular. Fine writing is, without doubt a most fascinating accomplishment—but there is a uniformity, even a want of individuality about much of the modern script strangely at variance with the acute desire for self-expression at all costs, which is so characteristic of the modern artist-craftsman. Again, though script is neither so slow nor so laborious as it looks, it is slow compared with ordinary writing, so that few people adopt it for ordinary purposes, and at the same time it does not by any means always influence the ordinary handwriting of those who practice it. This being the case, it is natural to enquire what will become of all the scribes? There is, after all, a very limited demand for testimonials and addresses, and the market for written books in these days of cheaper and ever cheaper printing, is bound to be a small one, and confined to the few who have long purses. Everyone must be glad that writing as an art has made the advances which it has done in these last few years. If there is any cause for regret, it is only that it has gone so entirely in one direction, and that one which, though admirable in itself, does not touch very closely the everyday life of the twentieth century.

Illumination.—From one point of view it is difficult to say where writing ends and illumination begins—but though in the recent revival the two arts have naturally gone hand in hand, the scribe and the illuminator are not necessarily one and the same person; and whilst the modern writers have founded themselves almost exclusively on one model, the illuminators of the present day have taken their inspiration from widely different places and have occasionally also struck out new lines for themselves. The more modest of them have contented themselves with renderings of Celtic ornament and interlacing, or with flowing scrollwork of the Gothic type, and have left figure work severely alone. There are artists, however, who aim at something a good deal more original than this, and amongst them Miss Kingsford, at least, has produced most elaborate and minute figure decoration, so delicate in colouring and so refined in treatment that it challenges comparison with the best of old work, whilst two or three other illuminators are doing work which, though far from simple, is very satisfactory. Illumination, naturally, is generally associated with writing but there is at least one worker (Mr. Vigers) who has tried with some measure of success the promising experiment of adding his hand illumination to printed books. Of course, the books thus adorned are, specially and very carefully printed, and the ornament is added to the pages before they are bound.

Lettering.—It is rather curious that the revival of writing has had so little effect upon lettering in general. Now and again we see the tickets in a shop window, or some other small announcement or advertisement, neatly set out in uncials or half-uncials instead of being adorned with the flourishes of the signwriter—but this is the exception rather than the rule. This is probably due partly to the fact that a quite considerable interest had been aroused in lettering in general some time before script became a subject of interest, and still more to the great variety of lettering demanded by different positions and different uses. Forms essentially suitable to writing would not, naturally enough, be equally satisfactory cut in wood or carved in stone. Still, the fact remains that while during the last few years the lettering on posters, advertisements, showcards, calendars and the like has been getting steadily better, its progress has been upon lines which have had little or no connection with script. Many eccentric and illegible alphabets have seen the light, letters have sometimes been distorted till they were all but unrecognisable; we have had a large variety of high-crossed A's, of H's sloping upward to a point, and of microscopic O's (these last, as some of the perpetrators were naive enough to admit, because big O's were so difficult to draw), and other absurdities. And it cannot be denied that commonplace, eccentric, and ugly lettering still abounds. One has only to look at the advertisements to see that there is plenty of room for improvement. For all that, lettering seems to be receiving much more serious consideration than it did. The average person has begun to be aware that lettering counts for something, and that it is possible to make or mar a design by it. And every now and again we do see posters and other advertisements, well lettered and carefully spaced, which show a desire to attract attention by their taste rather than by their vulgarity.

GENERAL NOTES.

BARCELONA INTERNATIONAL ART EXHIBITION. —The Board of Education have been informed through the Foreign Office that the municipality of Barcelona propose to hold a fifth International Art Exhibition in that city from the 23rd April to the 15th July, 1907, which may again be opened in September and October. The Exhibition will comprise the fine arts and art crafts generally. The time for receiving exhibits will extend from the 15th to the 30th March. Copies of the regulations containing particulars of the conditions upon which exhibits will be received and awards made may be obtained from the Spanish Consul-General in London, Senor Joaquin M. Torroja, 40, Trinity-square, E.C.

MANNHEIM HORTICULTURAL EXHIBITION, 1907. —The Board of Agriculture and Fisheries are informed that a Horticultural Exhibition will be held at Mannheim in the Grand Duchy of Baden from May to October, 1907. Exhibits from this country will be admitted to the fruit, vegetable, orchid, and cactus shows. Applications for information should be addressed to the Office of the Exhibition, Friedrichsplatz, 14, Mannheim, Germany. A copy of the provisional programme can be seen at the Offices of the Board, 4, Whitehall-place, S.W.

TRADE WITH PERSIA.—Some of the difficulties which handicap the trader who wishes to do business with Persia are indicated by His Majesty's Acting Consul-General in Khorassan, Major Kennion, in his report (Cd. 2682) just issued. Law, as understood in the United Kingdom, is practically non-existent in Persia. All questions which cannot be settled by arbitration are settled in the Karguzar's Court, nominally according to the Shariat, or religious law. On claims recovered in this manner fees are charged by the Karguzar amounting to 5 per cent. of the net amount. As to trade usages, Persian merchants are in the habit of acknowledging them or denying them as their own interest may seem to indicate for the time being. The foreign trading community especially feel the lack of laws dealing with—(1) Fraudulent bankruptcy; (2) identification of debtors' seals and signatures; (3) the payment of acceptances; (4) the enforcement of contracts; (5) noting and protesting bills of exchange. It follows that great care has to be exercised in ascertaining the character of Persian merchants before dealing with them if loss is to be avoided. Major Kennion says the Manager of the Imperial Bank of Persia at Meshed would usually be able to give useful advice in such matters. Notwithstanding the war and internal dissensions, the Russian monopoly of the supply of everything which she can produce seems to be still practically unchallenged. Other things being equal, it is impossible for British and Indian goods to compete with those of Russian origin in Khorassan. Favourable geographical conditions are the main factor in favour of Russia, whose organisation and methods are also superior. Russian merchants, recognising that those of Persia have little money and less enterprise, have invented a system by which, on making a small deposit, a trader can order goods and defer payment until he has actually sold them, or at any rate has purchasers in view.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. D. Hall, "Artificial Fertilisers: their Nature and Functions." (Lecture II.)

East India Association, Caxton-hall, Westminster, S.W., 4 p m. Mr. L. W. Ritch, "The Burden of the British Indian in South Africa."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. E. H. Blake, "Some Notes on Sanitary Law."

University of London, South Kensington, S.W., 8 p.m. Mr. Banister Fletcher, "The Parthenon." (Lecture III.).

Actuaries, Staples-inn-hall, Holborn, 5 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. R. Blathwayt, "Egypt: Past and Present."

TUESDAY, Nov. 27...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. W. A. P. Tait, "The Talla Water Supply of the Edinburgh and District Waterworks." 2. Mr. M. Ratcliffe Barnett, "Repairing a Limestone-Concrete Aqueduct." 3. Mr. E. P. Hill, "The Yield of Catchment-Areas."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. T. Manly, "Ozobrome."

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. J. C. Mellis, "St. Helena."

WEDNESDAY, Nov. 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. John William Gordon, "Patent-law Reform."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, Nov. 29...Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Rev. W. Manning, "The Middle Class."

FRIDAY, Nov. 30...Civil Engineers, 25, Great George-street, 8 p.m. (Students' Meeting.) Mr. P. A. Spalding, "Applications of Electricity in Printing Works."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m, Annual General Meeting.

Royal, Burlington-house, W., 4 p.m. Annual Meeting.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Discussion on Mr. Clarkson's paper, "Steam as a Motive Power for Public Service Vehicles."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 3, 8 p.m. (Cantor Lecture.) A. D. HALL, M.A., "Artificial Fertilisers: their Nature and Functions." (Lecture III.)

TUESDAY, DECEMBER 4, 4.30 p.m. (Colonial Section.) Sir LEWIS LLOYD MICHELL, "The Cape to Cairo Railway."

WEDNESDAY, DECEMBER 5, 8 p.m. Ordinary Meeting.) Colonel SIR CHARLES M. WATSON, K.C.M.G., C.B., "The Metric System."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 26th inst., Mr. A. D. HALL, Director of the Lawes Agricultural Trust, delivered the second lecture of his course on "Artificial Fertilisers: their Nature and Functions." The lectures will be published in the *Journal* during the Christmas recess.

NORTH LONDON EXHIBITION TRUST.

In 1865, the Committee of the North London Working-classes and Industrial Exhibition (1864), presented to the Society of Arts a sum of £157, the balance of the surplus from that Exhibition, with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art Workmanship Competitions were discontinued after 1870, but since that date various prizes have been awarded under this Trust. Prizes were offered to the students of the Artistic Crafts Department of the Northampton Institute, Clerkenwell, in 1903, and have been continued annually to the present time. These have been awarded, for the present year, as follows:—

1st prize (£7 7s.) to F. C. LATTER, for a Modelled Design for Fountain.

2nd prize (£4 4s.) to A. G. SPENCER, for an Engraved Copper Plate.

3rd prize (£3 3s.) to F. E. MEKELBURG, for an Engraved and Enamelled Cross, and Designs for Engraving.

ADJOURNED MEETING.

The discussion on Mr. John William Gordon's paper, read on Wednesday evening, 28th inst., was adjourned until Wednesday, January 16th, 1907.

PROCEEDINGS OF THE SOCIETY.

SECOND ORDINARY MEETING.

Wednesday, November 28th, 1906: Sir WILLIAM H. PREECE, K.C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Blake-Thomas, Hugh, Cawsand, Pwllheli, North Wales.

Bradley, Benjamin Lawrenson, Barn-ith Wood House, Grindleford, Derbyshire.

Middleton, Robert Hugh, 26, Selborne-road, Ilford, Essex.

Muntri, Kashinath Gorindjee, 192, Worlee, Bombay, India.

Shaw, Mrs. W. T., Hypatia-lodge, Percy-villas, Campden-hill, W.

Smith, Harry E., Wrexham-house, Winn-road, Lee, S.E.

Stewart, James Ernest, care of The Pekin Syndicate, Limited, Tientsin, China.

Wilberforce, Professor Lionel Robert, 5, Ashfield-road, Aigburth, Liverpool.

Wild, Albert Edward, care of Messrs. Henry S. King and Co., 65, Cornhill, E.C.

The paper read was—

PATENT-LAW REFORM.

By John William Gordon.

The reform of the Patent-law, a subject which is always more or less occupying public attention, is a matter with which the Society of Arts has in times past had a very special connection, and the discussion of the subject within its walls at the present time has therefore a peculiar fitness. For it was announced in the daily newspapers about the middle of last month that the Government would shortly bring in a Bill to amend the law relating to industrial patents, and it certainly is suitable that when a measure of that sort is in course of incubation its scope and provisions should be taken into consideration by this Society.

It is the more desirable that a body such as this Institution, which has a very honourable record in connection with the greatest reform of our Patent-laws ever attempted at one stroke, should now be heard, because in the discussion of the proposed reforms both critics of the existing law and propounders of new clauses are apt to forget that the patent law of the United Kingdom is a very venerable fabric, in which the British public may fairly be expected to take a reasonable and inoffensive pride.

A Patent-law is now an integral part of the legislation of almost all the civilised countries of the world, in fact, its establishment may perhaps be said to mark the stage at which industry escapes from the thraldom of patronage and the shackles of monopolies to become a freely developing and spontaneous growth, a self-contained and self-supporting department of the national activity. The Patent-laws of the world, numerous and various as they are, are all, directly or indirectly, derived from the Patent-law of this country. With us the Patent-law is indigenous. It has been formed to shape and use by strokes of fate which from the beginning of the sixteenth century have resounded through our national history. Little by little it has acquired consistency and system until at last it has arrived at such completeness that it can be embodied in a code and transferred as a whole, with such modifications as the wisdom or fancy of the borrower suggests, to the statute-books of other States. To the United States and to some of our own colonies the germ of our Patent-law was conveyed with the common law, which they inherited from the Motherland, but in countries like the various States of Europe, which have received from our system of law nothing but what they have expressly selected for appropriation, the scheme of our patent system has furnished a model upon which they have worked in the construction of their own systems and a model from the main lines of which no one of them has thought it wise to depart.

There is therefore much reason for a reverential feeling with respect to the British Patent-law, and it hardly can be matter of reproach that those who undertake its reform should wish to make themselves acquainted with its history. I assume, therefore, that in bringing this subject under your consideration this evening I may count upon your patience if I introduce what I have to say with a cursory sketch of the history of reform in our own Patent-law.

In speaking of the reform of Patent-law I refer, of course, to the law concerning patents for new inventions. It is no doubt true that Patent-law, in the full sense of the term, is concerned with all kinds of grants which pass the Great Seal. And it is equally true that for a full comprehension of the Patent-law it is necessary to have regard to those many matters, other than new inventions, which from time to time are treated in this way. But patents for inventions form a class apart, so completely separated from patents of other kinds that in common usage a patent and an invention not seldom mean the same thing, and for present purposes no object would be served by including patents of peerage, of precedence, and of a thousand other matters, in the survey.

The earliest reform in the law relating to patents of the kind which now concerns us was introduced by King James I., and, in fact, had very far-reaching consequences. Under his immediate predecessor on the English throne the mischief of monopolies conferred by patents had assumed very formidable dimensions, and had given rise to still more formidable discontents. While Queen Elizabeth lay on her death bed, the common law concerning grants of trading privileges was formulated in the famous case of D'Arcy against Allin, a decision reported by Sir Edward Coke under the title of "The Case of Monopolies." That decision—although rendered in a test case which had been specially remitted by the Queen to the Court of Queen's Bench for the determination, not only of the issues of fact, but also of the principle of law—was very unacceptable to the Court, and for a long time King James held himself in reserve upon the point, studying it, no doubt, as he studied other

points in the law, to him unfamiliar, of his southern kingdom. In 1610, however, when he had occupied the throne for seven years, and, as he himself said, had served a full apprenticeship to the craft of a king, he took and proclaimed a decision which was destined to become in later times the corner stone of the law of industrial privilege all the world over, and he devised a procedure which, for upwards of two hundred years, continued without change to be the machinery by which patent grants were applied for and conferred within this realm. The proclamation was issued in book form by the King's printer, and bears the quaint title—"A Declaration of His Majesties Royall pleasure, in what sort He thinketh fit to enlarge or reserve Himself in matters of Bountie." Sir Edward Coke, in his "Institutes," speaks of it more compendiously as the King's Book, and it is cited in the Statute of Monopolies as a publication in print containing "Your Majesties Declaration."

That part of King James's book which deals with machinery is now of purely antiquarian interest, and, although its antiquarian interest is very great, it must not detain us this evening. The pregnant sentence which has developed into a practically universal Patent-law at the present day is contained in the following words:—

"A memorial of those suits wherein we are contented to be moved by our servants and subjects, and to reward them according to the particular merit of the suitor. . ."

"9. Projects of new invention so they be not contrary to law nor mischievous to the State, by raising prices of commodities at home, or hurt of trade, or otherwise inconvenient."

King James's reform, had he succeeded in making it effective, would have completely satisfied the reformers of his own time, but it was much easier to formulate a rule of that sort than to enforce its observance, and consequently his effort did more to fix and define the popular demand for reform than to satisfy it. People said with irresistible force that inasmuch as grants had notoriously continued to be solicited and made in defiance of the proclamation, what was wanted was, not a mere re-issue of the Declaration, of which a second edition appeared in 1619, but a statute which should actually invalidate and set aside all these unwarrantable gifts, making them, not only irregular, but actually illegal.

With this object the Statute of Monopolies was passed in 1623, not without difficulty, as we know, nor without considerable opposition in behalf of the Crown and on the part of its wearer, as we infer from what Sir Edward Coke says about the matter. Nevertheless the Bill was passed embodying the sense and enacting the words of the King's own declaration. Very elaborate subsidiary clauses, intended to preclude all possible evasion, made up the bulk of the statute, but its kernel is contained in the sixth section, which exempts from the general denunciation of all restraints upon trade such patents for new manufactures as are granted

"For the term of fourteen years or under . . . of the sole working or making of any manner of new manufactures within this realm to the true and first inventors of such manufactures which others at the time of making such letters patents and grants shall not use, so as also they be not contrary to law nor mischievous to the State by raising prices of commodities at home or hurt of trade or generally inconvenient."

While the Legislature and the Courts were thus busy with the determination of the rule of law the Law Officer of the Crown was occupied with a less conspicuous reform and one which has had less permanent and less widespread consequences, but is of very particular interest to reformers of the Patent-law at the present day. The most exasperating of all the wrongs inflicted by patentees upon the community was an injunction. Injunctions in those days were not issued by Courts of Common Law, but were the common form in which relief was afforded by the Privy Council sitting for judicial purposes either in the Star Chamber or at the Council Board. The Privy Council exercised an extraordinary and discretionary jurisdiction which has been aptly described as criminal equity. Riots, contempt of the King, or of his officers, the maintenance of wrongdoers, or any offence against public order and government, which, by reason of the rank of the offender or of the force engaged upon the side of rebellion, threatened the peace, and was capable of offering an effectual resistance to the authority of the ordinary courts of law, came within the cognisance of the Privy Council, and the Privy Council disposed of forces much greater than the rudimentary police which enforced obedience to the Courts of Common Law. In turbulent times and for really public purposes a court like the Court of Star Chamber was invaluable, perhaps indispensable. At its worst it was notably better than those forms of anarchy which find favour in modern States,

and which, when irregular in origin, are called lynch law, and are named martial law when regularised by a legislative Act.

The general term by which all offences cognisable by the Privy Council could be denoted was contempt; sedition was contempt of the King's authority; maintenance, contempt of court, and so forth, just as in the Old World formula of an indictment at the present time, a crime charged against a prisoner is said to have been committed "against the Crown and dignity of our Lord the King." This is simple enough, and if the Star Chamber had confined itself to such great contempts as threaten the very existence of social order, it might not improbably have continued to this day an integral and indispensable part of the British constitution. But the doctrine of contempt was seized upon by the Court and the courtier party as an engine for extending the authority of the Crown at the expense of the popular franchises. If the Privy Council could restrain gross contempts, *à fortiori* it could restrain petty ones. So patentees sought its forum—they produced their grants, complained that infringers were treating the Royal Ordinance and the Great Seal with high contempt, and asked for injunctions to restrain infringements on that ground. In an evil hour for its reputation the Privy Council acceded to this demand. It entertained their suits and established a summary process for enforcing obedience to the King' grants. If a patent had been wrongly granted there was a Lord Chancellor with jurisdiction to cancel it, and there were courts of law which could investigate the question of validity. To them the oppressed public might have recourse to be relieved from an oppressive grant, but while the Seal remained upon the parchment it was high contempt to refuse obedience, and such contempt must be restrained by admonition and injunction, and punished by imprisonment and fine. Such seems to have been the doctrine of the Star Chamber and of the Council Board.

In the Statute of Monopolies this mischief is redressed by a clause which removed all questions arising upon patent grants from the jurisdiction of the Privy Council, and gave, in reference to these matters, an exclusive jurisdiction to the Courts of Common Law. About the same time—but this date cannot now be precisely ascertained—some law officer attacked the same problem from the other side. Who he was we do not know, but it is interesting to reflect that he may well have been Francis Bacon or Edward Coke. Both these great lawyers were much occupied with the reform of Patent-law, and each of them, we may be sure, would have approved a plan which mitigated the irrational harshness of Privy Council law. Whoever he was, he incorporated in the grant itself a proviso to the following effect:—

"If at any time hereafter it shall appear to us, our heirs and successors that this our grant shall be anyways prejudicial to our commonwealth or otherwise . . and after that declaration thereof shall be made by us under our privy seal . . . . or by any six or more of the Privy Council of us, these our letters patent and everything therein contained shall from thence-forth cease and be utterly void and frustrate."

The reference here to "six of our Privy Council," points unmistakably to the judicial Privy Council, for of that committee, six formed a quorum from the days of Edward VI. to the time of its abolition in 1640. The idea then, seems to have been this. That a defendant when convented before the Board would no longer be defenceless, though entitled to a good defence. He would answer the charge by denying the contempt, and support his denial by citing the proviso in his favour. Thus, even if the courtiers and patentees should succeed in getting the Statute of Monopolies repealed, or its provisions set at naught, they would find themselves confronted on the ground of their own choosing, with a royal defence of the popular liberties. So by the co-operation of all parties in the realm, by the deliverance of the judges, corroborated by the king's proclamation, ratified by Act of Parliament and completed by the ingenuity of the Law Officer of the Crown, the first great reform was brought about, and the broad foundations of an industrial Patent-law were securely laid.

It was long before any further reform was undertaken, and when it was eventually called for the demand arose chiefly out of the considerable part which James I. assigned in his system of procedure to the king himself. Twice was every application to be brought under his personal notice, and twice were the papers to receive the royal sign manual before a grant could be made. With the increased number and urgency of such applications in the times of George III. and of George IV., and with the delays which those monarchs introduced into the conduct of the business of a king, the Stuart system broke down hopelessly. Moreover, fees would seen somehow to have increased during the interval, and between expense and delay the granting of in-

dustrial patents was, in 1829, a branch of the public service which had fallen into scandalous disarray. In that year, a Parliamentary Committee sat to inquire into the subject, and subsequently made a report, which is a mine of information and suggestion, relating not only to the Patent-law of this country but to the principles and philosophy of Patent-law in general. The recommendations of that Committee did not, however, bear immediate fruit. Matters of more poignant interest absorbed the attention of Parliament and of the nation. The Reform Act of 1832 and the Corn-law agitation obscured those lesser matters—momentous as they were—which were bound up with Patent-law reform, and prior to 1852 only a few fragmentary and comparatively small changes were effected and those, such as they were, owed their form and promotion to that indefatigable law reformer, Lord Brougham. In the years immediately preceding 1850, however, a new influence made itself felt. The Society of Arts, founded in the middle of the eighteenth century, received about this time a great accession of strength. The time itself was propitious to reform. Law reform on a large scale had been carried through by Romilly and Brougham. The reform of representation had given new life to Parliament. The reform of taxation had made a good beginning with the repeal of the Corn-laws, and the thoughts of men were being visibly "broadened with the progress of the suns." The time seemed propitious also for carrying to completion the work of stimulating and directing industrial enterprise in this country, which since its foundation in 1754 had been the principal object of the Society of Arts. From very small beginnings it had developed a system of industrial exhibitions at which producers and manufacturers competed with one another for pre-eminence and carried on a commerce of ideas. At first such exhibitions were necessarily local institutions. Gradually, as they grew in popularity, they extended the range of what may perhaps be called their jurisdiction, and drew upon the whole kingdom for contributions and support. In this way the Society's exhibitions acquired a national character and a success which led to the adoption of the idea in other countries. Thus the notion of industrial exhibitions and acquaintance with the ends which they could be made to serve grew to be widely diffused. The national naturally suggested the international exhibition, but when that proposal took shape it met at first with strong opposition and denunciation. For the manufacturers of a country to exchange ideas with one another and to compete among themselves was reasonable enough and experience had shown it to be highly useful, but to invite foreigners to their councils would be madness, to lay themselves out to entertain foreign competitors would be Quixotic, to open a great fair at which foreign producers and manufacturers would be given free access to the home market, suicidal. The opposition can easily be understood. By what means it was met and overcome I do not know. I suppose that the fact is that in the career of every great people there are accesses of power, times of conscious strength and clear vision, when it can rise to the height of a great argument untroubled by timid fears or shallow prejudices and that the middle of the last century was such a moment in our history. Howsoever it come about, the fact is that the task which the Society undertook was successfully accomplished, the nation was persuaded to make the bold stroke, and the International Exhibition of 1851 inaugurated a new phase of the comity of nations, a phase which gave an innocent and co-operative aspect to international industrial rivalries.

The general results of the first International Exhibition do not this evening concern us, but its effect in promoting the reform of Patent-law was so marked as to furnish a second chapter to the story which I have to tell. The Exhibition of 1851 brought not only foreign visitors but also our own colonists to our shores in great numbers, and advantage was taken of their presence to elaborate a system of Patent-law applicable, not to the United Kingdom only, but to the British empire as a whole. Colonial patents down to that time had been few and, for the most part, issued, not under local statutes, but under the prerogative of the Crown. The men of that day saw a future for the British empire to which such primitive arrangements were wholly unsuited and, considering its requirements as a whole, they elaborated a scheme for bringing into existence what may be called an imperial patent grant. In outline the scheme was this. The holder of any existing British patent might apply in a colony in which his patented manufacture had not been introduced for local registration of his British grant. The effect of registration, when obtained, was to cause the original patent to run in the registering colony, and thus for the remainder of his term the patentee in Great Britain acquired the rights of a local patentee. In some colonies the

registration scheme was adopted, side by side with and as supplementary to a system of local patents. In other colonies it became what to this day it is in the colonies of St. Helena and the Falkland Islands, the only form in which a local patent grant could be obtained. But whether in substitution for or in supplement of a local grant, the system of local registration seems to have been a scheme most admirably adapted to the circumstances of a complex organism like the British Empire. The inventor who secured a British patent became immediately free of a great family of States. He could perfect his invention, complete his experimental work, accumulate capital, and when in this way his manufacture was a going concern, he could start a branch establishment in such colonies as required his industry under the protection of what was substantially a local patent for the residue of his original term. Such a system was the worthy product of a great age, and may reasonably have inspired the hope that in time to come the slow working of this common Patent-law would create a widely ramifying industrial system which would powerfully promote commerce between the various members of the whole, and create bonds strong though impalpable which would hold the daughter States to the Mother Country, ever growing in strength, but never liable to bear with hard or hurtful pressure upon any part.

But to the realisation of that fascinating hope something more was necessary than a scheme of Colonial laws. If the British grant was thus to become the source from which so large a stream should flow, it was important that the machinery for granting patents in Great Britain should be put in thorough working order, and this was accordingly taken in hand and carried out by the passing of the Patent-law Reform Act of 1852. The cumbrous machinery devised by King James for preventing the abuse of the Royal prerogative was replaced by simplified forms of application and more summary methods of dealing with the application when made; and a small Board of Commissioners, with an office and official staff, was substituted for the Home-office, Privy Seal, Lord Chancellor, and other departments through which, under King James's scheme, the luckless inventor had to run the gauntlet of official criticism. Minor improvements accompanied this great reform. A large reduction of fees made patents more available than before, and the introduction of the provisional specification closed the main door previously open to fraud. Prior to 1852, as now, the patent was granted for an invention specified only by a title in the grant itself. The nature of the invention denoted by this title was subsequently ascertained by a specification enrolled in Chancery under a proviso to that effect contained in the patent. Of course such specifications constantly varied — and sometimes fraudulently — from what the inventor had in his mind when his application was made and his patent granted. For when he came to prepare his specification he was preternaturally wise with that wisdom which comes after the event. To meet this difficulty the draughtsmen of the 1852 Act devised the provisional specification, which was to be an amplified title, describing, with all the fulness necessary for complete identification, the invention for which the grant was made. By these and a number of subordinate improvements the British Patent-law was brought into a shape in which, though modernised in all its aspects, it provided adequate expression for the ancient common law as it had been formulated by Popham, C.J., and the Judges of the Queen's Bench, proclaimed by King James and finally ascertained by Sir Edward Coke and the drafting committee over which he presided in the Parliament of 1623.

The Patent Act of 1852 furnishes the high-water mark of English legislation on the subject of patents. It was by no means final. The scheme of Imperial legislation, of which it formed a part, required for its fulfilment the Colonial Patent Registration Acts, which actually followed in due succession. It required also that at some later date the registration system should be extended so that when the Colonies came to have fully equipped and organised patent offices of their own the practice of registration might become reciprocal between all the different members of the Empire, and a patent taken in any one part of the dominions of the Crown might confer certain inchoate rights in all parts of the King's dominions, rights which might be matured and taken up at the patentee's convenience as his business resources grew. The opportunity for a grand development along these lines occurred in 1883 when the next measure of Patent-law reform was taken in hand. But the opportunity was missed. An Act was passed which indued many old things with new names and introduced one conspicuously abortive change into the law. But by 1883 the spring of ideas had run dry, the useful alterations then made were insignificant, and

a form of statute was minted which, being adopted by most of our self-governing Colonies and larger dependencies, put an end—for the time, at least—to all developments in the direction of drawing the Colonies closer to the Mother Country, and corroborating the loose ties by which Greater Britain is held together. No attempt was made to facilitate the registration of British patents in the Colonies, or to give the holder of a Colonial patent any privilege on an application for a British grant. The scheme which had been carefully elaborated by the statesmen assembled from every part of the Empire—at a time when the British nation at home and oversea was profoundly conscious of its essential unity and imposing strength—was ignored thirty years later, possibly even forgotten altogether, for the Act of 1883 appears to have been the work not of statesmen but of draughtsmen. Unfortunately the example so set was widely and consistently followed. Colonial Patent Acts on the model of our own Act of 1883 followed in quick succession and have abolished the registration system everywhere except in Barbados, the Straits Settlements, and two or three other Colonies.

The place of the destroyed system is now being taken, but very inadequately filled, by the International Convention. This Convention, as you know, was originally drawn up for the purpose of facilitating what may be roughly described as an interchange of patent rights between a singularly heterogeneous assortment of States having no political union whatever. The signatories represented the kingdoms of Belgium, Spain, Italy, the Netherlands and Servia, the French Republic, the Republics of Guatemala, Salvador, and the Swiss Confederation, and the Empire of Brazil. By later accession our own country and some others have come into the treaty, and among our colonies, New Zealand, Queensland, Tasmania, Western Australia, and Ceylon, have adhered to the arrangement. This treaty, no doubt, effects as much as can be effected in the direction of facilitating patent grants to foreigners, and assimilating systems of jurisprudence so divergent in their nature as the Roman Dutch law and the Code Napoleon. By the irony of fate it is replacing in our own domestic system the family arrangement set up, but left necessarily imperfect in 1852, and as it comes into effect is reducing our Colonies one by one to the same footing in this respect as foreign countries. Since time does not permit me to discuss this matter at large, I will not enter upon it further, but in turning away from it I trust that I may be allowed to say, with the emphasis of a personal conviction, that it is wise not to take for granted and without critical inquiry, that the newer is the better plan.

In the cursory sketch, which is all that I can this evening attempt of the course which reform of our Patent-law has hitherto taken, there is not much that I need add, but even a cursory sketch would be incomplete without some reference to the Act of 1902, which has crowned and completed the work of 1883. The Act of 1883 introduced, as you know, a system of compulsory licenses, that is to say, of licenses which patentees might in certain cases be compelled to grant, in order to secure the establishment within the realm of industries protected by patent grants. The mischief which was aimed at by the measure is a curious one. That a patentee should obtain a patent grant for the purpose of enabling him to set up a manufacture here and then hang back from manufacturing, and even prohibit the establishment of the industry which he has undertaken to promote, seems on the face of it a ridiculous situation; a situation so ridiculous that it might not unreasonably be thought to be impossible. But impossible situations are constantly arising in practice and, in truth, the explanation of this anomaly is quite simple. There are, in fact, two perfectly distinct reasons for which applicants seek patent grants. One applicant desires to practice his invention and create by means of it a profitable trade, the profit of which shall in the main accrue to him. Another desires, not to practice trade, but to control it. He is quite content that other people should do the trade provided that he is privileged to lay a tax upon it. If both succeed, the one secures profit—the other toll. Now the one whose property is in the toll is not of necessity concerned with the manufacture at all. It suits him equally well to obtain his toll from something else which he has not invented. And this can very often be contrived with but a fraction of the ingenuity in which inventors, as a class, are rich. It is especially easy in the case of patents granted for chemical processes where mere words count necessarily for much, and mere opinions even for more. The palmary illustration is the case, often told, of the Blackley Red Dye. A patentee, whom I will call B, invents and patents a brown dye stuff which turns out to be of no commercial value. People cannot be

induced to buy it. Consequently there is no profit in it, and in the hands of a patentee of the manufacturer class it is a worthless grant. But time passes. Another inventor, whom I will call L, invents another dye, a red dye, for which there is a great demand. There is a considerable resemblance from the chemists' point of view—although very little from that of the practical man—the dyer—between the two substances. Both are hydrocarbons, both are derived from coal tar, both contain sulphur. The chemists are strongly of opinion that in passing from coal tar to red dye L must have passed through what I may for simplicity call a brown stage. Nobody of course pretends that a brown dye emerged at any stage. But in the existing state of our knowledge it is quite conceivable that incidentally and momentarily in the manufacturing operation the red dye stuff passed through a brown phase. That is enough for the patentee who lies in wait to take toll. Neither he nor anybody else can find any profit in his own invention, but it is quite conceivable that L in the course of making something else incurs a loss by reason of it, for eminent chemists can be brought to opine that in making the valuable red he must needs incur the expense of incidentally, momentarily, and wastefully producing the patented brown. Here then, if a court can be persuaded to act upon the conjectures of eminent scientific men, is a manufacturer who is at last practising the manufacture of the brown dye and yet contriving to make a profit on his business, taken as a whole. Clearly he is a man who can pay toll. Why should he not pay?

You will think perhaps that there would be an obvious answer to that question inasmuch as the invention from which he derived the profit was his own: that if the patentee is entitled to a share of anything at all it must be a share of the incidental loss, which the theoretical use of the patented invention entails. But that would be very old-fashioned Patent-law, and it is not at all difficult to explain how an inconvenient alternative like that is at the present day evaded altogether. It has, you will remember, been assumed that our patentee for this occasion is not concerned with profit. Therefore he does not ask for profit and so avoids all discussion as to the amount of the profit to be divided, or the source from which it comes. He asks the court to give him—not profit—but control. In the language of the law he asks for an injunction to restrain the manufacture of which he complains, and if the court will give him that, he willingly undertakes to manage the rest for himself. The audacity of such a demand is bewildering to anyone who stops to consider what it means.

An injunction is a legal contrivance for changing an unlawful act into a crime. The difference is well recognised in our law, and indeed in all civilised systems of law. For instance, it is an unlawful act to leave a just debt unpaid, but we do not now arrest the debtor, and clap him into gaol. He is constrained by gentler means to satisfy his creditor. Since the year 1869, our Legislature has carefully and consistently refrained from rating the defaulting debtor as a criminal at all, recognising, with a wise discernment, that the penalties of crime are not appropriate to all forms of shortcoming.

The rule of the Legislature was at one time the rule also of our courts. It was said that the remedy of injunction was an extraordinary remedy to which recourse should be had only when less stringent methods of coercion were shown to be inadequate to the requirements of the case. So lately as 1878, Lord Cairns laid down the rule that, in certain cases—the particular case with which he was dealing being a breach of covenant—a court of equity will see that by interposing, instead of leaving the parties to their remedy in damages, it would be doing more harm than it could possibly do good, and that in such a case it will take account of various incidental matters.

"It will consider, for example," said he, "whether the injury which it is asked to restrain is an injury which if done cannot be remedied. It will consider whether, if done, it can or cannot be sufficiently atoned for by the payment of a sum of money in damages. It will also ask this question—suppose the act to be done would the right to damages for it be decided exhaustively, once and for all, by one action or would there necessarily be a repetition of actions for the purpose of recovering damages from time to time. Those are matters which a Court of Equity would well look to and, on the other hand, a Court of Equity would look to this. If we interfere and say, in aid of this affirmative convenant that something shall not be done which would be a departure from it no doubt we shall succour and help the plaintiff who comes for our assistance. But shall we do that? Will the effect of our doing that be to cause possible damage to the defendant very much greater than any possible advantage we can give to the plantiff. Now, in a case of that kind where there is an amount of discretion which the court must exercise those are all considerations which the court will carefully entertain before it decides how it will exercise its discretion."

The case that we are considering is pre-eminently a case for the exercise of discretion. The patentee usually desires more than he is entitled to obtain in the way of relief even if his complaint of infringement be well founded. For argument can hardly be necessary to prove that profit and not control is what sound policy assigns to an inventor and what in fact a British patent is intended to convey to the patentee. There is a great risk that by the injunction, the court may give to him not profit but control. There is still another reason for caution. It is a principle of our law, as the passage just cited shows, that when the real matter of controversy is a breach of contract the courts will be somewhat slow to interfere by injunction and turn the mere breach into a crime. It would be easy, were this the proper place, to show that the wisdom of that rule is no less conspicuous than its mildness. Now the principle of the rule applies to the case of a discussion about the infringement of a patent right. At worst it is a breach of privilege; it can hardly be contended that the privilege is more sacred than a contract. In fact, the privilege itself has been described upon high judicial authority as a species of contract between the public and the patentee. For such a breach there is—special circumstances apart—an effectual and sufficient remedy in the awarding of damages to be paid by the infringer to the patentee. In that way the patentee comes by his own, that is to say, the profit of the invention. Of course, there may be cases in which the infringer is obstinate and irresponsible, will not regulate his conduct by the judgment of the court, and cannot be made to pay for his default. A case like that, no doubt, calls for the extraordinary remedy, and if an injunction makes such a defendant liable to imprisonment for a repetition of his breach, that would be entirely in conformity with the whole spirit of our law. But that, in fact, is not what happens. I do not suppose that there is a Judge upon our Bench who ever had to consider an application for an injunction based upon the ground that the infringer acted with knowledge that what he was doing was unlawful, or was persistent in his acts of infringement, or was an irresponsible person who could not be made answerable for damages and costs if these were awarded against him. Arguments like those would be treated as superfluous at the present day. The Act of 1852 gave to the courts a large power to grant injunctions in patent actions, a power which was still further enlarged by the Act of 1883. But whereas in 1852 the power was exercised with discrimination and more or less upon the principles just discussed, the courts now think it always fit to grant an injunction as part of the ordinary remedy in an ordinary case if the plaintiff succeeds.

You will now have no difficulty in perceiving how this new practice of the courts is exploited by the toll-collecting patentee. In the Blackley red case, for example, there was no question as to the extent of the injury suffered by the patentee, or whether he had suffered any injury at all. The fact that neither he nor anybody else could make a profit out of his manufacture did not enter into the reckoning, in fact there was no reckoning at all. The court was satisfied that the invisible, intangible, instantaneous brown stage in the red dye manufacture was infringement, and violated the patentee's exclusive right to make a loss by working the patented invention. So an injunction issued to restrain that improvident proceeding on the part of L, and incidentally, to restrain also his working of the very profitable manufacture of the red dye stuff which was his own invention. The commercial result in the case which I have mentioned was a great calamity, for not only did the control of L's invention pass into B's hands, but a large dependent dyeing industry passed bodily from Lancashire to Holland. The Lancashire dyers were compelled to allow the trade to pass into the hands of Dutchmen, for they were unable to obtain the dye either from the man who had invented, but was restrained from making it, or from the man who controlled the manufacture, but refused to supply it to them on equal terms with more favoured customers abroad. Thus a patent in which there is not a pennyworth of profit may be made the instrument of an extortion by which a prosperous trade, to the establishment and prosperity of which the patentee has contributed nothing whatever, may be reduced under his control, and taxed or destroyed for his emolument or for the consolidation of his grip upon our trade.

There are other ways in which a patentee can extend his privilege to the control of a trade which he has not himself either created or improved. He may, for example, be the patentee of an improved form of mantle for incandescent gas lamps. His mantles may be so highly efficient as to be in great request. But he may think that he would like to monopolise not only the trade in his own mantles, but also the trade in gas burners of the Bunsen type. If so, it is quite a simple

thing for him to sell his mantles with a condition that they shall only be mounted upon Bunsen burners bought from him. In a case like that the law was actually laid down in the year 1895 by a Judge of the Queen's Bench Division in these terms :—

"The patentee has the sole right of using and selling the articles, and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are."

I have quoted this judgment textually because I should not hope, had I ventured to paraphrase it, to escape the suspicion of having travestied the doctrine of the Court. It is, perhaps, open to me to add that, although somewhat strongly expressed, this dictum may be taken to be substantially in accordance with the prevailing judicial view at the present time, so that an argument founded on the provisions of the statute law and of the patent grant itself for protecting the free industries of the realm, and preventing hurt of trade and inconvenience to the public, falls upon deaf ears when addressed to English Judges.

This encouragement afforded to patentees to exercise their ingenuity in preying upon other people's trade, has, of course, borne fruit, not only in one or two, but in a great variety of ways in recent times. One of the most subtle and, as I venture to think, one of the most dangerous by reason of its subtlety, may be illustrated by the following imaginary case. A patentee, whom I will call S., invents a sewing machine suitable for the manufacture of shoes. It is an excellent machine, and greatly cheapens and improves the manufacture. He takes a patent, and, being a man of capital, sets up the manufacture of his own machines. So far all is well. He is carrying out precisely the object for which the patent was granted to him. But on the principle that he may attach any conditions, however unreasonable, to the use of his invention by the public he refuses to sell his machines when made, and will only let them out on hiring agreements. Into these agreements he introduces conditions as to the purchase of thread and other materials, which enable him to create a business in those commodities, which is restricted to himself, and so, little by little, to build up a system of tied houses in the shoe trade. If his machine is good enough it will, of course, enable his dependents to beat other manufacturers in the competition of the market, and will eventually place the lucky patentee in such a position of financial control that the whole trade will have to do his bidding. Ultimately, when his patents lapse, it will be found that his business position is so strong that he will be able to take the profits of the shoe manufacturers just as a brewer takes the profits of the innkeepers whom he puts into his own public houses. When that stage is reached there will of course be, no further improvement in that trade. The original inventor has no motive to invent further even if he is still able so to do, and it is his business to see that no other inventor shall poach upon his preserve. The first advance was real, the initial advantage substantial, but the doctrine that a patentee is entitled not only to the profit, but, also, to the control of trade, is a ruinous doctrine in the end, and leads to that melancholy issue that "one good custom should corrupt the world."

I will ask you to bear with me if I advance yet another case in illustration of this point and of the many aspects which it wears, although I am very conscious that I must not consume your time this evening with the mere recital of facts. In this case, however, the recital will be more than mere fact, for the facts themselves sufficiently appear from the judgment which I propose to cite; and again, lest I should be suspected of inaccuracy, I will cite the judgment by the textual quotation of the important parts. The judgment was delivered so lately as July, 1904, and deals, not in general propositions merely, but expressly and in terms with the point which we are now considering. It expresses, therefore, in the most pointed and authentic form the law with which Patent-law reformers have to deal:—

"The case raised by the defence," said the learned Judge, "is one of a most unusual character. Each patent is admitted to be useful; it is admitted that the invention is properly described in the specification; it is admitted that there is no anticipation. Therefore, so far as the ordinary grounds upon which the question of validity or invalidity is discussed in this court, it is admitted that the patents are valid. But the defendants raise this defence, which I will state shortly without reading the particulars of objections. They say the patentee never intended to manufacture, and does not manufacture, the dye-stuffs in this country, and makes use of his patents to prevent other persons from doing so, and they say further that he makes use of the privilege granted to him by the patents—to put it shortly—by selling the dye-stuff at an exorbitant and unreasonable price,

and to the serious disadvantage of our people, as compared with the people in certain other countries in which the dye-stuff is sold at a lower price.

"So far as the facts are concerned, I have this: The plaintiffs have never manufactured in England. The ground which they put forward as a reason for their not having manufactured in England is that alcohol forms an important element in the manufacture of this product, and that the excise laws in England impose such a duty upon alcohol as that the manufacture cannot be carried on at a profit in this country. Whether this reason be a good or a bad one does not really concern me, but at all events, it is not an unreasonable one, and it commends itself as having some reasonableness behind it. I think I must infer, also, that from the first they never intended to manufacture in this country. I have it also proved that the dye-stuffs are sold in this country at a price considerably higher than that at which they are sold in certain other countries, and in particular I will take Switzerland as an example. But it happens that in Switzerland and, as I gather, in all other countries in which these dye-stuffs are sold at a price considerably under that at which they are sold in this country, there is no patent protection for chemical products, and so the plaintiffs have to suffer from competition, and the consequence of that is that they are compelled in those countries where they have competition to sell at a lower price. So also in certain countries where they have protection they are exposed to more or less infringement, and according as the infringement is more or less so again in those countries they are driven to make their prices lower or higher. Certain examples were given at a period some years ago, when the stuff in this country was sold at 30s., and the infringing material was sold at 15s. I am asked to infer from a comparison of these prices that the price charged by the plaintiff company was such an exorbitant and unreasonable price that on that ground alone the patent ought to be declared void or revoked. I cannot on these facts come to any such conclusion. There may have been various circumstances affecting the manufacture of the patented article which determined the price, and it is impossible for me on the facts, therefore, to come to the conclusion that the prices at which they have sold are so exorbitant and unreasonable as on that ground, assuming that the case of The King v. Eyre—and I only assume it for the moment—is a general anthority for the invalidity of a patent where the patentee makes use of it by charging an exorbitant and unreasonable price—assuming that to be an authority in the present case, I cannot on the facts come to the conclusion that the present case falls within that authority.

"Am I to refuse to give the plaintiffs relief on the other ground, which is the ground mainly put forward . . . namely, that the patentee did not intend to manufacture and does not manufacture the articles in this country? It is put in this way. It is said that *primâ facie* all monopolies are bad in law, that at the common law a monopoly was good if it was for the introduction of a new manufacture into this country by which employment was increased and the general prosperity of the country was contributed to."

The learned Judge then proceeded to discuss the authorities for this contention, and arrived at the conclusion that such a condition was not essential to the validity of the patent, which he accordingly upheld.

In order not to break up the statement of the case I have advanced beyond the year 1883 in my narrative, but that will not, I hope, cause you any inconvenience, for in asking you now to carry your minds back to that year I am not asking you to shut your eyes to what has since occurred. These later developments only exhibit in its mature plumage a mischief which was a fledgling in 1883 and while, therefore, it would be unfair if we were seeking to cast blame upon the legislators of that time to dwell on facts which could then only be discerned in embryo, it is otherwise on an occasion, like the present, when we are concerned with measures and not with men. The inadequacy of the measures then adopted can be better understood in the light of subsequent events.

It is then in the light of these fuller illustrations that you should consider the clause introduced into the Act of 1883 for dealing practically with the case of obstructive patents used by their owners either mainly or incidentally for the destruction or injuring of our trade. The clause forms the 22nd section of the Act and gave power to the Board of Trade to make an order in a proper case directing the patentee to grant a license under his patent upon terms settled by the Board. It was provided, and this provision proved in the end fatal to the scheme, that the section should commence life with a period of hybernation, for a saving clause exempted all then existing patents from its operation. Thus at first, and for many years, there was nothing for the section to operate upon, and when at last some bold adventurer proposed to set it in motion he found his task like that of waking the sleeping beauty. Nobody knew the way, and his path was obstructed at every step by a rank growth of thorny obstacles, the outcome of misappropriated time. It is not so that practical legislation originates, and if no other cause had intervened this alone would suffice to explain the abortive attempt at remedial legislation. But, in fact, another and more serious defect hampered its operation. The tribunal selected was not appropriate for deal-

ing with that particular matter. I do not mean to suggest a want of competence and even of special competence in the Board of Trade. Far from it. When eventually the jurisdiction came to be exercised, it was in fact, confided to very competent hands and administered in a manner which gave little ground, so far as I can understand the matter, for complaint. Substantially what complaint was made was a complaint concerning expense, but that is a matter which neither Parliament nor the tribunal could control. Commercial men fighting about their commercial interests are keen to get the best professional assistance, cost what it may. For this reason proceedings touching their interests, whatever their form, are expensive, and I suppose it will be so so long as there is a fashion in lawyers. I have never yet heard of a proposal by which the settling of terms of license between hostile parties could be rendered inexpensive or even materially cheapened.

The weakness of the tribunal arose from this fact, that it could only deal with a part of the matter in controversy. The demand for a compulsory license only arises when a manufacturer is threatened with a patent action, and if he has then to carry on litigation in two courts, his case is of necessity very hard. His defence in an ordinary case is really threefold:—1. Your patent is bad. 2. Even if good, it does not cover my manufacture. 3. Even if wrong under heads 1 and 2, I ought not to be restrained, but only compelled to pay you a reasonable royalty. Now, it is an old maxim of our law that "Circuity is to be avoided." To send litigants first to the High Court to get an injunction, and then to the Board of Trade to get rid of it was the worst possible form of legislation, tending to confound confusion and multiply expense. Since the first and second issues could only be decided in a court of law, the third ought to have been remitted to the High Court also. The whole controversy would then have been disposed of at one trial, and the question of the license decided without additional expense. It is no matter for wonder that an enactment so wholly at variance with elementary principles of legislation should have miscarried in the result. It contained a promise of relief, but a promise only, which must be redeemed, if ever, by means of some more workmanlike Act of Parliament at some future time.

A show was made of redeeming that promise three years ago, when the Patent-law Amendment Act of 1902 was passed. One principal subject of that Act was the grant of compulsory licenses, and, as in 1883, so in 1902, there was much shuffling of words with the idea of improving the expression of what had come to be the settled law. These amendments were probably not intended to have much effect, and certainly could not have effected much in the way of change in the substance or operation of the law. But in the report of the Departmental Committee upon which that Act was founded, and in the Bill, as originally presented to the House of Commons, was one provision which would have been revolutionary, and, like the true lover's kiss, have awakened the sleeper to youthful life and activity. It was at first proposed that the jurisdiction in matters of compulsory licenses should be transferred to the High Court. On second reading, however, the Government of the day withdrew that proposal, and for the High Court substituted a composite tribunal—the Board of Trade for preliminary investigation, and the Privy Council for final decision and settlement. This was "circuity" with a vengeance. Under the Act of 1883, the Board of Trade if satisfied with the *primâ facie* case made out by the applicant, could at once appoint a referee who would deal with the case forthwith and, save for the great defect which has just been pointed out, this was a perfectly satisfactory procedure. Certainly in respect of expense and expedition it was all that could be reasonably asked. Under the Act of 1902, the Board of Trade if satisfied as to the *primâ facie* case must send the applicant to the Judicial Committee, the most expensive court of first instance in the realm, and the Judicial Committee, if satisfied in turn with the applicant's case, must send him to a referee for the discussion and settlement of terms with the possibility of another hearing, and further argument upon the consideration by the Committee of the referee's report. To do justice to this method of amending the law, one must have recourse to something like Rehoboam's truculent threat, "My little finger shall be thicker than my father's loins." You did not greatly wonder that the Act of 1883 failed. You can hardly wonder more that the Act of 1902 has proved abortive.

But in truth it is not merely in respect of machinery that these acts are inadequate. If you consider them in the light of the mischief, as you can now see it, which they were intended to remedy, you will perceive that at the best a compulsory license does not deal with more than a small part of the case. Take, for ex-

ample, the mischief of the tied-house system. The sufferers are not competitors with the patentee in his own trade. In the case which I put before you, by way of illustration, they were bootmakers and he was a maker of bootmaking machinery. Why should a bootmaker want a license to make sewing machines? What he wants is the opportunity of buying them. A mere license to make or to use will not afford him the chance to buy, and for this case no form of license can afford a remedy. So again with the man who wants to furnish his existing gas burners with a new mantle. He is in no difficulty about the license, what he wants (and reasonably wants) is the opportunity of buying at market price. A compulsory license, if it can be had under reasonable conditions, may meet a case like the red-dye case, but that is only one of many forms which the mischief takes and therefore something more is wanted. What is that something?

To this question two answers have been proposed, and both, as I venture to think, are worthy of your careful consideration at the present time. The first has been much under discussion for several years past, and is to the effect that every patentee should be by law required to bring his invention into use, or to work his patent, as it is phrased, within the realm. This is perhaps proposed rather as an alternative to compulsory licensing than as a supplementary measure, for it is evident that it is, no more than that other, a remedy for the "unreasonable conditions" of use which our courts have so emphatically sanctioned. The tied-house system and the unreasonable license system would flourish no less than at present under a system of compulsory working. But for a part of the mischief, that is to say, for the injury inflicted on our trade by patentees who use their patent right to restrict the British market to goods manufactured abroad, it would afford a remedy. This mischief is in fact a very serious one; so serious that it is not at all surprising that on the part of commercial men it should have been considered apart, and to the exclusion of those other injuries which are less apparent to a cursory survey of the subject.

The argument is that it is the patentee's business to introduce his manufacture, and it is right that on him should be cast the burden of starting the business himself or of finding a licensee to start it for him. "Therefore," say the advocates of this measure, "shift the burden from the applicant for a license and turn the patent-holder into an applicant for a licensee. That is the logic of the situation if patents are granted for the purpose of establishing new manufactures within the realm." This contention appears to be broadly sound, but the principle is a little difficult of application. There are, for example, many patents granted for meritorious inventions which, nevertheless, it is not desirable to have worked within the realm. Let me give you, by way of illustration, the original patent for the incandescent electric lamp. The patentee described some five or six different ways of making the carbon filament which was the essential feature of his lamp. But improvement followed hard upon the heels of his invention. Before his patent could be exploited in this country he had himself invented an improved filament so much superior to those at first proposed that they at once became obsolete, and were never, in fact, manufactured at all. In such a case it would be childish to say: "You must plod on with the manufacture of inferior filaments, for which there is no use, in order to maintain your master patent." Take another case, which must be put in a hypothetical shape, although based on materials supplied by a lecture delivered at the Royal Institution last season by Professor Silvanus Thompson. Suppose, then, that some inventor were to devise a way of producing nitrate of soda from the nitrogen of the air. Suppose that this method could be carried out in Norway, where water power is abundant, so as to produce nitrate in unlimited quantity at a cost less than the present cost of South American nitrate. That would be a matter of capital importance to the British grower of wheat. A patent for such an invention might prove of the very highest value to the farmers of this country. But it may well be that if you were to require the patentee to carry on his manufacture in this country, where water power is small and not very available, the industry would be stifled, for the cost of nitrate manufactured by steam power might well be prohibitive. Such cases might be multiplied indefinitely, for, although generally true, it is by no means always true that manufacture beyond the realm of a patented article is an injury to British trade. The requirement of compulsory working is, therefore, one which needs to be imposed with carefully-considered limitations; but, given a rule elastic enough and equitable in operation, there is no doubt that for certain mischiefs it would be a remedy. And there is no reason to suppose that such a rule cannot be framed.

The other answer which I have to bring under your notice is more far-reaching and intended to go to the root of the matter and to deal with the mischief as a whole. You will have observed that all the schemes which predaceous patentees have elaborated for obtaining control of trade turn upon the injunction. The man with a patent for brown dyes captured the trade in red by means of an injunction. The man who tried to make the householder renew his gas fittings relied on an injunction to restrain the use of his mantles except upon terms of his own imposing. The man who planned a tied-house system of shoe manufacture could refuse to sell or even to let, except on his own terms, because he knew that the court would restrain by its injunction any breach of the conditions which it suited him to attach to the use of his machines. The foreign manufacturer who doubled the price of his goods to his English customers and diverted their dyeing industry to other countries was able to do so because the court by its injunction made the importation of that patentee's own goods from dealers in Switzerland, to whom he himself had freely sold them, a crime punishable by imprisonment at the discretion of the court. It is an injunction granted as a matter of course and without any regard to such circumstantial matters as those mentioned by Lord Cairns, granted without any regard to the convenience of the public or the hurt of trade, which is in every case the source and immediate cause of all the harm. Damages, the old common law remedy for infringement of patent right, suffice to secure to the patentee his profit—all to which he is in reason and sound law entitled, but give him no control. Damages in the red dye case could at the most have amounted to no more than a nominal sum, for actual damage there was none. But the control given by the injunction cost the Lancashire dyers thousands upon thousands of pounds. So with the other case. How ridiculous a patentee's complaint would sound if he asked for damages because a customer, who insisted on buying mantles at their full market price, refused to buy from him burners which he, the customer, did not want, and he, the intending seller, had not patented. So stated, the matter is unmistakably clear, the reason of it shines out, the unreason of it is manifest flagrant. But when the injunction is asked for and granted as a matter of course, and of ordinary relief, it all becomes inscrutable. Argument falls on deaf ears when Judges can declare that a patentee is entitled to press his privilege, however unreasonably, agains the public. It is the negation of all rule. In place of law we have the Roman lady's despotic maxim, "Sic volo, sic jubeo, stet pro ratione voluntas."

This proposal, then, is simply that the older practice with regard to the injunction should be restored; that the mischievous clause which says "that in an action for infringement, the Court or a Judge may . . . . make such order for an injunction . . . . as the Court or a Judge may see fit" should be repealed; and, in place of it, that the law should be laid down once more in the sense of the rule laid down in the still unrepealed clauses of the Statute of Monopolies, and now neglected only because the abolition of the Star Chamber has made the meaning of that old statute somewhat obscure, and the growth in recent years of the practice of granting injunctions without regard to incidental consequences has dethroned reason in our courts of law. The mischief has now gone so far that a remedy must be sought at the hands of the Legislature; and I venture respectfully to suggest for the consideration of the Society of Arts whether it is not fitting, at a time when Patent-law reform is being officially taken in hand, that the principles upon which this terrible jurisdiction to grant injunctions ought to be administered should be carefully considered by the Legislature and accurately defined by the authority of Parliament itself.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said the paper was not only a criticism of the existing law, but an extremely interesting historical *résumé* of the growth of Patent-law in this country. No doubt many had heard with surprise that Patent-law was indigenous to England, and that English law had been the root of all Patent-laws in every other country. It was also surprising to learn from the author that, from the days of James I., in 1623, to the days of Victoria, in 1852, no attempt had been made to reform the Patent-law. It must, however, be remembered that in 1851, as the author had pointed out, one of the greatest events in the industrial history of Great Britain happened, namely, the Exhibition of that year, promoted by the then President of the Society of Arts, the Prince Consort. Personally, he had been a good deal concerned with patents. His first patent, relating to duplex telegraphy, was taken out in 1853, so that he had long experience as a patentee of the working of the Patent-laws, and his experience of the taking out

of a patent from a commercial point of view was that it was worth less. He did not think he had ever made any money from any patent he had taken out, although his name figured pretty abundantly among patents, the reason being that while the law controlled the taking out of patents, finance and commerce settled the profit a patentee would obtain from them, and the two did not always agree. The author had stated that, however well the Act of 1852 worked until 1883, from that date up to the passing of the last Reform Act of 1902, confusion had followed instead of assistance to the public and the patentee. The author had certainly made out a very good case that the reform of the Patent Acts should be taken into very deep consideration by the Society of Arts. The subject was brought before the Council of the British Association in 1901, and a committee formed to consider it, but it was thought better to wait and see the operation of the Act of 1902 before troubling about any further reform. One curious feature in the paper was that while the law itself was pronounced by the Judges of the land, they had nothing whatever to do with the enactment of the law. A Bill was brought forward generally by a Department of the Government, after consideration in committee; a new Act was passed, and it was only when it became law that the Judges had to pronounce an opinion on it. It seemed only common sense that in the passing of an Act requiring the judgment of a Bench of Judges, a committee of Judges should be in existence which would take into consideration the accuracy of the enactment of new laws. The subject was of intense interest, and would no doubt produce an excellent discussion, and if the necessity should arise he would be prepared to consider the advisability of adjourning it to a future meeting.

Mr. Ivan Levinstein said that on the whole he entirely agreed with the author's paper, although there were a few points to which he took some exception. In the first instance, he would like to know how the travesty of justice had arisen in connection with the law as it originally stood. The author had not fully explained how it came about that the legal decisions were in absolute opposition to the law which still existed, a law laid down by the Statute of Monopolies. The State gave an important and most valuable asset to the patentee, viz., a sole and exclusive privilege, and naturally expected some service in return. The Legislators of James I. enacted that the sole and exclusive privileges were given on the condition that a new manufacture was introduced into the country in order to find work for its people and to generally benefit trade. How the travesty of the original law had arisen was perhaps difficult to say, but he thought it had been occasionally due to clever counsel and accommodating experts who had bamboozled the court to such an extent that at the finish of the case, the Judge knew less about it than at the beginning. The deputation which had recently waited upon the Board of Trade, and which was not solely represented, as the author appeared to think, by commercial men, but by inventors, learned societies, and more than 250,000 workpeople, asked the President of the Board of Trade to reinstate the law as laid down in the Statute of Monopolies, with several provisos. It did not ask that every patentee must work his patent, but that a patentee should only be called upon to work his patent in this country if he worked it abroad. A second proviso was that he need not be called upon to work it in this country if he justified his inaction to the satisfaction of the Board of Trade. There was a vast difference between those provisos and the simple fact that a patentee should be called upon to work his patent in this country; because it would be very hard to enact that, if a patentee did not do so his patent should be forfeited, inasmuch as the patentee might not have overcome the initial difficulties. It might take three, four, five, or six years to get a patent worked, and there was therefore great difficulty in fixing any term within which the patent must be worked. It would also be very hard that a poor patentee who could not get the necessary capital within a reasonable time should lose the benefit of his invention. In order to overcome these difficulties the resolutions which he had had the honour of moving on several occasions at the meetings of the Associated Chambers of Commerce, and which were unanimously passed, distinctly set forth that the patentee should only be called upon to work his patent in this country if he worked it exclusively abroad, unless he justified his inaction to the satisfaction of the Board of Trade. The author thought that the application of a law for compulsory working would create a difficulty, but the illustrations he had given did not bear out that view. There were very few patents indeed which could not be worked in this country which were worked abroad. Mr. Gordon had referred to the incandescent electric lamp case as one of his illustrations to prove the difficulty of application; but that example would meet with no difficulty whatever, because if the processes had not been worked abroad the manufacturer could not be called upon to lose his patent. With regard to the second illustration, the manufacture of nitrate of lime from the nitrogen of air, it might be of interest to state that a company had been formed in Germany with one million capital, which had been fortified with additional capital from France, so that the joint company would command a capital of four million pounds, for the production of nitrate of lime for fertilising purposes. The process was by no means confined to Norway, as it could be carried out in many other countries; but even that illustration would be fully met by the resolution of the Associated Chambers of Commerce, which contained the proviso that the patentee must justify his inaction to the satisfaction of the Board of Trade. If it was the fact that there was no water-power in this country, or that cheap fuel cou'd not compete

with water-power, there would be no difficulty whatever in proving to the satisfaction of the Board of Trade that the process could not be satisfactorily carried out in this country. He had, therefore, come to the conclusion that the author's carefully selected illustrations did not meet the difficulties he suggested in the application of compulsory working. This country had lost millions of pounds by its foolishness in not insisting on compulsory working. Eight thousand patents per annum were granted in this country to foreign patentees, and the only return they gave for that privilege was that they could impose the most intolerant and absurd conditions upon our trade as shown by the author. By working British monopolies exclusively abroad, our own workmen were thrown out of employment, whilst the patentee did not contribute a farthing to Imperial or local taxation. Not only were new industries thus established in foreign countries, but, worse than that, when the legal term of the patent had lapsed, in many cases there was no one in this country who could continue the process for which a British monopoly had been given. We possessed neither the machinery nor the men, and frequently did not know the process which the foreigner was carrying out—he referred chiefly in this instance to chemical processes—the result being that many of the monopolies which had been granted had become perpetual monopolies. The present Government had promised that they would introduce a Bill incorporating the principles of the Associated Chambers of Commerce resolution; if such a Bill were passed it would confer a real boon on the industries of this country, because there was no doubt whatever that new industries and new manufactures would be introduced. So far as the stability of trade in this country was concerned, one of its greatest disadvantages was that it relied chiefly on a few staple industries.

Sir JOSEPH LAWRENCE, after thanking the author for his excellent paper, said the Chairman had dwelt upon the drawbacks the Judges were under in interpreting Acts of Parliament passed by the Legislature without their having had anything to do with the framing of the Bills in the first instance. The difficulty he experienced in regard to the measure of 1902, which he assisted Mr. Gerald Balfour very considerably in carrying was, that they were legislating on the basis of a report prepared by a Departmental Committee which largely consisted of lawyers. He felt there was not a man on that committee who was practically and commercially acquainted with the working of patented industries, the result being that the great reform for which the commercial community of the country had been crying aloud for nearly 40 years was never touched in the slightest degree; in fact, the present Lord Chief Justice, who was a member of the committee, said when the question was raised, that the committee was not met to discuss the economic question. The terms of reference to the committee were extremely narrow, and excluded the questions which the commercial and manufacturing community desired to be discussed. For nearly thirty years, Mr. Levinstein had been agitating on the question at the Associated Chambers of Commerce and Chemical Institutions. He was the man who called attention to the prospective loss of the aniline dye industry, a great question which was not even referred to by the committee. The reformers were told by the lawyers that the matter could not be remedied, and even Mr. Gordon at one time held that view, but he was fast coming round to an opposite opinion. It had now become necessary for the laymen to tell the lawyers of this country what was done by the laws and legislatures of other countries. In this connection, he desired, to save time, to quote from an article of his own, which appeared in the October number of the *National Review*, as to what was being done in Germany, a country which was going ahead by leaps and bounds. He there said: "A long series of successful actions for the revocation of patents in Germany, on the ground of non-working, show that the question considered by the Courts is whether the Commonwealth has suffered, or is likely to suffer, by the neglect of the patentee to work his patent in the country. The law keeps the common weal in view in compelling the working of the patent in Germany. The production must contribute to the advancement of inland commercial industry. The articles protected by the patent must be produced in the country. The patentee cannot excuse himself from the legal obligation to work his patent by the plea that there is no remunerative demand for the patented article. Only *bonâ fide* efforts to work are of any avail; part of the work being done in Germany will not be regarded as working 'to an adequate extent.' In no case is it admitted that the patentee can delay working till he has a certain prospect of a market to recoup him for his outlay. As recently as April, 1904, a patent for stoppered bottles was revoked because, though the bottles had been made in Germany, the aluminium stoppers had been imported. One of the reasons given by the German Court is noteworthy. "Because aluminium is cheap in Germany, German industry as such has an interest in the patent being worked in this country.'" He quoted in the House of Commons the celebrated case of Gruson, of Magdeburg, who held a patent for armoured trains in France. The French officials contended that the two years within which he ought to have manufactured in that country under his patent had expired. The patentee replied that there was only one customer for armoured trains in France—the Government—that he offered the patent to the Government who, after considering it for eighteen months, declined it. Nevertheless, the French patent office confiscated the patent. It was untrue, historically and in fact, to say that compulsory working was not enforced on the Continent. It was enforced to such an extent that it was a colossal disadvantage to English industry. Five years ago Mr. Levinstein and

himself headed a powerful deputation from various Chambers of Commerce, representative of all shades of political opinion, to the then President of the Board of Trade with the object of amending the Bill of 1902, which was framed on the recommendation of lawyers, and he then stated that the Bill was an instance of the way in which English commercial industries were menaced by the present Patent-laws. The whole system of English Patent-laws had been overlaid by the subtleties of the law. He had a high appreciation of Mr. Gordon's enormous learning on the question of patents, because no man had devoted himself to the question with a higher sense of duty, singleness of purpose, and a profounder desire to remedy the present evils than Mr. Gordon had done; and if the author did not see absolutely eye to eye with Mr. Levinstein and himself, yet he had a strong eye for justice, and was gradually beginning to realise that they were not such fools as they had hitherto been represented to be by lawyers, and that good solid common sense was at the basis of what they were working for. He thought they could take some comfort from the results of their endeavours. For years they had been pegging away in the Associated Chambers of Commerce, with the result that two unanimous resolutions had now been passed recommending the policy which Mr. Levinstein had brought forward, namely, that where a foreigner took out a patent in this country and worked it in his own, he must come here also and work it in order to give employment to English people, which was one of the conditions upon which the original patent rights were granted. That followed a sound good policy, and it furthermore staved off very grave injustices which had been inflicted upon English people in the past. For instance, everybody knew the celebrated case in which Mr. Levinstein sought to get elementary justice by carrying the case to the highest court, and failed. People in Germany took out patents for manufacturing dye stuffs which vitally hit Mr. Levinstein's business; Mr. Levinstein unsuccessfully endeavoured to obtain a compulsory license, with the result that the German manufacturers seriously interfered with the trade of every chemical manufacturer in this country. Mr. Gordon set out very strongly the evils of patentees owning the control and profits, but suggested no remedy, only recommending very warmly a very pet view of his, namely, some restriction being placed on the power of Judges to grant injunctions. He did not think that people engaged in manufacture in this country were particularly anxious about that, and there had been no pronouncement upon the part of any of the public bodies of this country in favour of limiting that power. He knew of a recent case where the exercise of that power by the Judges had a just and wholesome effect. Some foreigners came over to England and introduced an industry, which was a gross infringement of an existing patent, and if they had been allowed to go on, the manufacturer, whose business was prejudiced, would not have had a bawbee left by the time he had taken all the necessary legal steps through the courts up to the House of Lords. In such a case it was a very wholesome power to keep unrestricted, and he thought the Judges might be trusted to exercise a very fair discretion, because they were men animated by a high sense of justice and fairplay. He would do nothing to restrict that power; in any case he would not lessen their powers of discretion. He frankly admitted that the Act of 1902 was a dead letter. They asked for the power of compulsory working, but were not granted it, the bugbear of the Convention being thrown in their faces. They were not asked as a body to give evidence before the Departmental Committee, and consequently their views were not known. On the occasion of the last deputation to the Board of Trade, he told the President that he did not desire to place any disability upon any foreign patentee which he, as an Englishman, was not prepared to submit to. Mr. Lloyd George at once said that that was the only point that had hitherto divided them, and agreed that they had absolutely made out their case, and, on a subsequent occasion, informed them that he intended to bring in a Bill on the lines the deputation recommended. There was, therefore, a prospect of what they had been fighting for for so many years, being realised before long, and he trusted they would have the loyal help and support of Mr. Gordon in the framing of the measure which would be brought before Parliament. A Bill had already been drafted and laid before the President of the Board of Trade which, he believed, would meet with the unanimous support of all parties in the House, of all the commercial and manufacturing community, and last, but not least, of the legal powers of the country. The difficulty he experienced in the House of Commons was that, whilst he had certain able patent counsel on one side supporting the commercial interests, there were other lawyers on the other side who were frightened to death to do anything to disturb the Ark of the Covenant. He told them it would have to be done, and by dint of hard work he thought they were in a fair way of getting it accomplished.

The CHAIRMAN announced that, owing to the number of gentlemen who were desirous of speaking, it had been decided to adjourn the discussion to Wednesday, January 16th, 1907, the first evening meeting after the Christmas recess.

THE CANADIAN FUR TRADE.

For more than two centuries, the fur trade has been vigorously prosecuted in Northern Canada, and yet the supply, save in the case of two or three varieties of animals, shows no great signs of exhaustion. The buffalo, whose hide was once an important article of commerce, has disappeared before the advance of civilisation. The beaver can apparently only be saved from a similar fate by extraordinary measures of pro-

tection; so too the fur seal of the islands and waters of the Pacific. Sea otter and silver fox have been rare for many years. What the home consumption amounts to, can only be surmised. According to the Canadian statistical returns, the export of furs to the United Kingdom and the United States amounted respectively to £297,000 and £131,000 in the year 1904. The total value of furs exported from Canada amounted in the year 1904 to £448,000. Besides Great Britain and the United States, France and Germany are importers of Canadian furs. Competition from such influential sources as the Hudson's Bay Company, working from Winnipeg; Revillon Frères (from Edmonton) and other extensive fur buyers maintaining posts all over the north, from Labrador to Mackenzie River and beyond, has according to the United States Consul at Dawson City, cut down the local trade in furs, and introduced arbitrary rates and precarious dealings, rendering trade on a small scale, hazardous. In Yukon Territory, the marten has recently migrated, owing, it is said, to the appearance upon the scene of unusual numbers of lynx. This condition is probably only passing and temporary. Fur buyers seem to agree that the fur-bearing animals of the north, with the exceptions noted, are not becoming extinct. Vast extents of territory still remain approximately virgin and unexploited, and the Indians are proving surprisingly careful in preserving the game. The Indians bring the skins to the various posts, and exchange them for merchandise; it is all a matter of barter. The standard of value in some parts is a beaver skin; in others, the skin of the red fox. In the interior of Alaska, the price paid for furs and supplies are regulated by the price of the red fox or of the marten, called one skin. London continues to rank as the principal fur market of the world, to which are shipped furs from Asia, including Siberia, Europe, and America. Subsidiary markets are Tacoma, St. Louis, Montreal, New York, Paris, Leipzig, Novgorod and Kiakhta. In the world's fur trade, Alaska plays no insignificant part. The exports of Alaskan furs for the twelve months ended June 30th, 1904, amounted in value to £93,000, and for the twelve months ended June 30th, 1905, to £103,000. Great quantities of furs are taken in Alaska, embracing those of the polar bear, black bear, brown bear, black wolf; white, red, blue and silver grey foxes, badger, beaver, sables and seals. It is known that Alaska has yielded great wealth to this industry, but the extent cannot be stated with any certainty, as it has been the policy of the fur trader to conceal his operations, and the conditions of the trade are such that he is able to do so. The annual collection of furs is a matter of ceaseless change. Fashion, fastidious and fickle, neglects the use of certain kinds of furs for a season, the market price of the pelt no longer repays the outfit of the trapper; the hunt is intermittent, and in two or three years the animal regains its numbers and strength. Owing to the steady growth in the demand for furs in nearly all countries, and also as a result of the establishment of peace between Japan and Russia—the latter country being generally a large consumer of furs—fur merchants appear fairly satisfied with the outlook, fearing no serious set back, provided fictitious boom conditions and inflation do not interfere.

THE EFFECTS OF TUBERCULOSIS ON THE FRENCH POPULATION.

The Academy of Medecine, at Paris, has been recently discussing the value of the official statistics regarding the mortality from tuberculosis in France. According to these statistics, 150,000 persons die each year in France from this disease. This represents 39 deaths, caused by tuberculosis, out of every 10,000; while in Germany, it is said, the same malady carries off only 22 persons in 10,000. This fact has led to a critical examination of French vital statistics, and, during the discussion at the Academy, many interesting facts have been brought out, showing the basis on which these statistics have been established. Definite information is received from only 713 cities and towns having a population of more than 5,000 inhabitants, making a total of 12,000,000 inhabitants, among whom the mortality from tuberculosis amounts to 42,000 per annum. This has served as a basis of calculation for the rest of the country that furnishes no reliable statistics, and to this is added the deaths from chronic bronchitis (approximately 50,000), making, in this way, a total of 150,000 deaths from tuberculosis. In Germany, it is stated, chronic bronchitis is excluded, and account is only taken of cases of tuberculosis proper, or even only of pulmonary tuberculosis. Allowance must also be made in both countries for errors in diagnosis. Indeed no malady is apparently so subject to being cut up, divided, and hidden away under various names and classifications in the statistics. According to the American Consular representative in Paris, Professor Albert Robin has established from the statistics of 1901, 1902, and 1903, that tuberculosis decreases in an almost regular proportion to the density of the population. He has accordingly compiled a table of deaths from tuberculosis in France during the year 1903, showing the percentage of deaths per 10,000 inhabitants to be 45·2 in Paris; in cities of 100,000 to 492,000 inhabitants, 34·4; in cities of 30,000 to 100,000 inhabitants, 32·8; in cities of 20,000 to 30,000 inhabitants, 30·8; in cities of 10,000 to 20,000 inhabitants, 26·6; in cities of 5,000 to 10,000 inhabitants, 23·4; and in cities of 1,000 to 5,000 inhabitants, 20·4. This calculation brings the rate close to the German average, and led Professor Robin to express his belief that the German system of popular sanatoria had less merit than public measures of hygiene and sanitation. A great many medical men, however, believe that even the French official figures are below the reality. Those deaths reported as from "unknown causes" amount to 28 per cent., and undoubtedly include many cases of tuberculosis. For instance, in ten of the principal country towns, out of 47,490 deaths, 10,178 were

classified under "other causes." In towns of medium importance, such as Roanne, out of 34,000 inhabitants and 723 deaths, the statistics indicate 74 deaths from tuberculosis, 342 from "other causes," and 20 from "unknown causes." It is much the same everywhere. At Nanterre, more than half the deaths were without any information as to causes. The consensus of opinion, therefore, would seem to be that it is almost impossible to make any serious deductions or comparisons from the official statistics as at present organised, owing to their incompleteness and, in some cases, inaccuracy. While some departments, like that of the Seine, furnish absolutely exact statistics as to tuberculosis, others do not furnish any at all. Another cause in inaccuracy is the evident lack of sincerity in declaring the cause of death. In certain towns, since the declaration of death from tuberculosis has been made obligatory, only persons in hospitals die from that disease; the rich die from bronchitis. So also in Paris, the death-rate from tuberculosis in the Champs Elysées quarter is only 10·5 to 11 per 10,000 inhabitants, while at Plaisance it amounts to 105. The campaign against tuberculosis in France has assumed such national importance that the French Academy of Medecine has very recently been discussing the necessity for the compulsory declaration of cases of tuberculosis by the doctor in attendance, but this has been met with a storm of opposition, as it is claimed that thereby a large number of consumptives would be deprived of all means of support, since no one would then knowingly have them in their employ. The question of the effect of certain occupations on tuberculosis has been carefully investigated in France, it has been found that those trades that bring persons into contact with dust, are especially dangerous. Professor Landouzy's investigations among policemen and postal *employés*—both of whom have very insanitary offices—indeed the public complaints against the impure air in post-offices in Paris are most frequent—and also among laundry workers, have revealed a disastrous condition of affairs. Also among 245 workmen, carefully kept under observation by Professor Landouzy, consisting of carpenters, joiners, floor layers, and packers, all living under practically the same conditions, the mortality from tuberculosis amounted to more than 30 per cent. Laundry workers, however, were found to be the most seriously affected. The Paris bakers, a short time ago, formed an organisation for the improvement of insanitary conditions under which they have to work. It is stated authoritatively that despite the governmental inspection of bakeries, and the most modern hygienic apparatus, large numbers of bakers suffer from tuberculosis. The State Department of Public Charities regarding this struggle against tuberculosis as a national and social duty, is considering the establishment of special hospitals for tuberculosis, both in Paris and throughout the country, where patients can be properly isolated, and given special treatment.

HOME INDUSTRIES.

The End of the Shipbuilding Strike.—The hope expressed in these notes on November 9th has been fulfilled, and the shipbuilding crisis on the Clyde is at an end. As demonstrated here more than once, the strike was predoomed to failure. It was a belated strike. A year or eighteen months earlier a case might have been made out for a rise in wages, but it was not submitted, and when the demand was made the employers said not only that the prospects of the trade would not warrant it, but that unless trade improved, it would not be possible to continue to find work for all the present hands. Under those circumstances concession to the demands of the strikers was plainly impossible. This has been so obvious that the trade unions as a whole had no sympathy with the strike, and regretted the obstinacy of the boiler makers, who, in the pursuit of ends that could not be achieved, brought privation and misery on other workers without their resources. If the strikers had not recognised the truth when they did there would have been a lock out—which would have added greatly to the distress. Fortunately the men were brought to see the facts of the situation in time to prevent the threatened lock out, and their unconditional surrender has ended the crisis. They have resumed work at the rates they were obtaining when they ceased work. Unfortunately, with the continuance of the present demand for steel and steel making iron, there is not much likelihood of shipbuilders securing many coutracts of importance for new ships during the winter months; and it must be expected, that there will be less and less to do in the shipyards as the work in hand is finished.

Railways and Trade.—The growth of the foreign trade of the United Kingdom during the last two years has been great. Exports have grown by 27 per cent, and imports by 9 per cent. It is less easy to gauge the home trade; exact data are wanting. It is notorious that the building trade has been slack, and the consuming trades are complaining. But as to trade generally, there is no better test of trade than railway earnings. They carry the raw materials for mauufacture, and the manufactured goods for shipment, or to the point for distribution; they carry the food for the maintenance of most of the people of the country, and convey all but local travellers from place to place. If the railways are active, if their earnings show satisfacfactory increase, then it is pretty safe to assume that the districts they serve have little to complain of as touching trade. If this test is a true one, then there is little to complain of in the present state of trade. In the first half of the present year the expansion in railway gross earnings was about 3½ per cent., and it may be assumed that for 1906 the growth of trade as reflected by railway traffic will be nearly 3 per cent. compared with 1905, or 5 per cent. as compared with 1904, a very satisfactory growth. The *Statist* of November 24th gives a very interesting table indicating the state of trade in

the current year, in contrast with that of 1905 and 1904, and in contrast with the usual rate of growth it gives a contrast of the receipts of British railways in each year since 1870. The growth in gross earnings over this period is very remarkable. In 1870, when trade was very active, the year, it will be remembered, that Mr. Chamberlain took for comparison with 1903, the gross earnings of the railway system of the United Kingdom amounted to £45,078,000; in 1905 they were £112,500,000, and in 1906 (the gross earnings of the December half being partly estimated) £115,500,000. In the present year the growth of trade, as reflected by railway traffic, will be nearly 3 per cent. over that of last year. The largest expansions in railway earnings in 1906, as compared with 1905, taking the first twenty weeks of the current half-year, are shown by the North Eastern, £243,000; North Western, £178,000; Great Western, £132,000; and Midland, £106,000, the exceptional increase of the North Eastern being explained by the great activity of the coal and iron industries in the north-east portion of England. It is estimated that the increase in the earnings of the nineteen principal railway companies during the current half-year will not be less than £1,300,000, but much of this will be swallowed up by the higher prices of material and coal and expenditure on improvements. The sum required to pay an additional dividend at the rate of $\frac{1}{4}$ per cent. upon the ordinary capitals of the nineteen companies is £323,000, and an average improvement in the dividend distribution of the companies of from $\frac{1}{8}$ to $\frac{1}{4}$ per cent. may be reasonably anticipated.

The Merchant Shipping Bill.—There are many clauses of the Merchant Shipping Bill which has now passed the House of Commons to which experts take exception, as for example the clause that practically deprives the local Marine Boards of the most important of the functions bestowed on them by the Act of 1854, but on the whole it seems to be the general verdict of instructed opinion that the Bill proceeds on the right lines, and should be of some considerable service to the shipping world. It is hopeful that on the whole the President of the Board of Trade, recognising that British shipping is our foremost industry, and that undue meddling with it might work irreparable harm, has worked with rather than in opposition to the shipowners. The clauses affecting seamen go some way to meet their complaints as to feeding and bunking, legitimate complaints that have had a good deal to do with the unwillingness of young men to "go to sea." That part of the Bill which relates to the application of British load-line regulations to foreign ships has been most keenly discussed, and it may be hoped that it will result in the only permanently satisfactory solution, namely, an international agreement. If it be true that the German Goverment are anxious to have their load-line defined on the same scale as the British, there ought to be no insuperable difficulty to the settlement of this vexed question before the amending Act comes into operation in 1908. The Government recognised that it was impossible to accede to the wishes of a considerable number of their supporters, and penalise the master or owner of a foreign ship for leaving a home port deeper than British regulations permit, it being only possible to deal with the load-line as it appears in British waters. Many will regret that the Bill does not deal in more drastic fashion with the foreign element in the British marine, but the question is much less simple than it appears to the layman. Still, a beginning has been made.

Cotton and the Empire.—The second annual report of the British Cotton Growing Association is very encouraging, and will be read with much satisfaction by those who recognise the importance of growing the cotton required by Lancashire within the limits of the Empire. It is a little strange that an Association having for its object this most desirable result, and supported and controlled by some of the most prominent men in Lancashire, should have failed to receive the public support necessary to the full subscription of its nominal capital of £500,000, only £247,000 having been subscribed. It may be hoped, however, that before long the whole of the balance will be found. The council urgently appeal for more capital to develop the cotton cultivation of West Africa, stating that the expenditure next year in that region will be £50,000, while in 1908 probably £100,000 will be wanted. The Council state they have every reason to believe that the loss on working, which has been greatly reduced, will be further reduced next year, and that in 1908 they will be able to show an even account, and possibly a profit. The report goes so far as to say that, "The time for experiment has passed. The case is proved. All the cotton Lancashire requires can be grown within the limits of the Empire." That is true, but we seem to be far from the time when it will be a fact. As the report admits, if the industry is to be made an absolute success it will require fostering for many years, hence the importance of the work of the Association, and of its obtaining the necessary funds to pursue its work. Details of the work accomplished in India and the several colonies accompany the report. In India, 20,411,000 acres are now devoted to cotton, and the crop in 1905-6 amounted 3,240,000 bales, but much of it does not come to England. It has been practically established that Egyptian cotton can be successfully grown in India, and Sind may be expected to supplement the Egyptian crop. Substantial progress has been made in the West Indies. Not only has the area under cotton largely increased, but the quality has been well maintained, and in many cases improved. The planters have obtained good prices, the better growths fetching 2d. to 3d. per pound over similar grades of American cotton. Four thousand and forty-two bales of West Indian cotton passed through

the hands of the Association in 1906, and realised £68,674, as compared with £28,331, for 1,746 bales, in 1905. In West Africa the progress has been very gratifying, and has exceeded the expectations of the council. In a year or two equally good results are looked for from Northern Nigeria to those already achieved in Lagos; on a smaller scale, too, the Gold Coast, Sierra Leone, and Southern Nigeria may be expected to contribute. The results of cotton growing in British Central Africa have not as yet been great, and in South Africa the Association has been unable to take any active steps, but advice and assistance have been readily given, and there is fair prospect of the establishment of cotton growing as a permanent industry. It will be seen that the Association is doing good work in many directions, but its efforts are still far from meeting the yearly increase in the world's consumption of cotton, and it must be many years before Lancashire's dependence upon the Southern States of America is materially affected.

The Drainage of Mines.—An interesting experiment is being tried in Cumberland in connection with the drainage of mines. Most of the iron mines in Furness and West Cumberland are heavily watered, and frequently, owing to surface drainage, the water finds its way, in some measure, into the workings again. Electric pumps have recently been adopted by a company owning large iron mines in Furness to deal with the water, and they are now engaged in putting the pumps down. They will not be handicapped with the ordinary pumping gear. All the power exercised on the motors will be used on the pumps themselves, and it is expected that not only will great economy result, but that when the new system is in full operation there will not be any need to close a mine when a breakdown takes place at the pumps, as it will only mean a sectional stoppage. The experiment will be watched with much interest by other mine owners in the district, and it is to be hoped that the results confidently anticipated from this introduction of electric power will ensue. If they do it will mean much to the district and others similarly situated.

GENERAL NOTES.

Coachbuilding Prizes.—The Company of Coach Makers and Coach-harness Makers of London offer the following prizes for competition among British subjects engaged in the trades of coach and coach-harness making, motor-body making, and accessory trades, and members of drawing and technical classes in connection with such trades, resident in the United Kingdom of Great Britain and Ireland. Competition No. 1 (open to all)—For drawings of a double victoria, without doors, for one or a pair of horses, to seat four persons inside; lever brake; side and half back elevations; scale 3 inches to the foot; 1st prize, the Company's silver medal and £4 4s.; 2nd prize, the Company's bronze medal and £2 2s. Competition No. 2 (open to all, except teachers)—For drawings of a small, light motor-car body, to seat two persons, suitable for a country medical practitioner; side elevation, half back, and half plan; scale 3 inches to the foot; 1st prize, £3 3s.; 2nd prize, £2 2s.; 3rd prize, £1 1s. Competition No. 3 (confined to coach and motor-body painters)—For the best specimens of painting, the whole of which from the priming to the last coat of varnish must be the work of the competitor; the specimens being one mahogany panel and one aluminium or pressed steel panel, surrounded with a flat moulding with a quirk and painted any colour, with or without black stripes, and twelve half spokes each to be twelve inches long, two painted crimson lake, two napier green, and eight of any colours selected by the competitor, all relieved by lines of suitable colours; 1st prize, £3 3s.; 2nd prize, £2 2s.; 3rd prize, £1 1s. Competition No. 4 (open to all)—The Master, F. Wykeham Chancellor, M.A., offers £10 10s., and the Company offer a silver medal and £7 7s. as below:—For drawings of a three-quarter landaulette motor-car body (*i.e.*, with light behind standing pillar), with wings and platform step, extension front and screen, to carry four persons in the body and one by the side of the chauffeur, the outline of chassis, wheels, levers and steering wheel to be shown; side view to be closed and half plan; scale 3 inches to the foot; 1st prize, the Company's silver medal and £10 10s.; 2nd prize, the Company's bronze medal and £5 5s.; 3rd prize, £2 2s. Competition No. 5 (open to those under 18 years of age who have never won a prize in the Company's competitions)—For drawings of a four-wheel station luggage cart, to carry two or four persons; side view; scale 2 inches to the foot; 1st prize, £2 2s.; 2nd prize, £1 1s. Competition No. 6 (open to all)—For drawings of six monograms, 3 inches in size, suitable for a carriage panel:—F.W.C., R.G.A., J.S.B., E.W.W., A.C., C.T.B.; 1st prize, £3 3s.; 2nd prize, £1 1s. The above prizes will be accompanied by the certificate of the Company.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

December 5.—"The Metric System." By Colonel Sir Charles M. Watson, K.C.M.G., C.B. Sir David Gill, K.C.B., F.R.S., will preside.

December 12.—"Fruit Growing and the Protection of Birds." By Cecil H. Hooper, Member of the Council of the National Fruit-Growers' Association.

December 19.—"Modern Developments of Flour-Milling." By Albert E. Humphries, President of the Incorporated Association of British and Irish Millers. Professor Thomas Hudson Middleton, M.A., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

DECEMBER 4.—"The Cape to Cairo Railway." By THE HON. SIR LEWIS MICHELL, late Member of the Cape Ministry. THE RIGHT HON. VISCOUNT MILNER, G.C.B., G.C.M.G., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

DECEMBER 13.—"The Indian Mohammedans: their Past, Present, and Future." By A. YUSUF ALI, M.A., LL.M. (Cantab.), I.C.S. LORD AMPTHILL, G.C.S.I, G.C.I.E., will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

DECEMBER 18.—"Basket-Making." By THOMAS OKEY. LEWIS FOREMAN DAY, F.S.A., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

A. D. HALL, M.A., Director of Lawes Agricultural Trust, "Artificial Fertilisers: their Nature and Functions." Five Lectures.

LECTURE III.—DECEMBER 3.—*Nitrogenous Fertilisers.*

JUVENILE LECTURES.

Two Lectures suitable for a Juvenile audience will be delivered on Wednesday afternoons, January 2 and 9, 1907, at 5 o'clock.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 3...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. D. Hall, "Artificial Fertilisers: their Nature and Functions." (Lecture III.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Messrs. W. Pollard Digby and C. H. Shenton, "Prevention of the Bacterial Contamination of Streams and Oyster Beds."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. H. W. Rowell, "The Direct Estimation of Antimony." 2. Mr. M. Wynter Blyth, "Bacterial Method of Investigating Disinfectants." 3. Dr. J. Gordon Parker and H. Garner Bennett, "The Detannisation of Solutions in the Analysis of Tanning Materials."

University of London, South Kensington, S.W., 8 p.m. Mr. Banister Fletcher, "Greek Temples of the Ionic Order."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. G. C. Haité, "Design and Designers of the Victorian Era."

TUESDAY, DEC. 4...SOCIETY OF ARTS, John-street, Adelphi, 4½ p.m. (Colonial Section.) Hon. Sir Lewis Michell, "The Cape to Cairo Railway."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussions on following papers:—1. Mr. W. A. P. Tait, "The Talla Water-Supply of the Edinburgh and District Waterworks." 2. Mr. M. Ratcliffe Barnett, "Repairing a Limestone-Concrete Aqueduct." 3. Mr. E. P. Hill, "The Yield of Catchment Areas."

Designers, 6½, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. Hugh Stannus, "The Korinthic Capital."

Tramways and Light Railways Association, Westminster Palace Hotel, S.W., 4½ p.m. General Meeting.

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Demonstration of Three-Colour Photography by the Rotary Photographic Company.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Cold Storage and Ice Association, London Chamber of Commerce, Oxford-court, Cannon-street, E.C., 7½ p.m. Mr. W. Worby Beaumont, "Motor Traction in the Cold Storage and Ice Industries."

WEDNESDAY, DEC. 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Colonel Sir Charles M. Watson, "The Metric System."

Geological, Burlington-house, W., 8 p.m.

African, Criterion Restaurant, Piccadilly-circus, W., 8 p.m. Sir J. West Ridgway, "The Transvaal and Orange River Colony."

Entomological, 11, Chandos-street, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Philip M. Johnston, "Church Chests of the 13th Century in England."

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, DEC. 6..Antiquaries, Burlington-house, W., 8½ p.m.

Royal, Burlington-house, W., 4 p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Professor A. J. Ewart, "A Contribution to the Physiology of the Museum Beetle, *Anthrenus museorum* (Linn.)." 2. Mr. E. Burdon, "Note on the Origin of the name *Chermes* or *Kermes*." 3. Dr. A. T. Masterman, "An Abnormal Specimen of a Dab with three eyes." 4. Rev. H. Purefoy FitzGerald, "A Note on *Siegesbeckia orientalis* (Linn.)."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. J. S. Lumsden, "The Liquid Volume of a Dissolved Substance." 2. Mr. W. H. Perkin, junr., and R. Robinson, "Some Derivatives of Benzophenone. Synthesis of Substances Occurring in Coco-bark." (Preliminary Notice.) 3. Mr. J. L. Simonsen, "A Synthesis of Terebic, Terpenylic, and Homoterpenylic Acids."

London Institution, Finsbury-circus, E.C., 6 p.m. Professor Hans Wesseley, "Chamber Music."

United Service Institution, Whitehall, S.W., 3 p.m. Lieut. C. Bellairs, "The Standard of Naval Strength."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. R. J. P. Briggs, "Boilers and their Accessories."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Prof. J. Epstein's paper, "Selection and Testing of Materials for Construction of Electrical Machinery."

FRIDAY, DEC. 7...Geologists' Association, University College, W.C., 8 p.m. Dr. Arthur W. Rowe, "The Zones of the White Chalk of the English Coast (Part V.—Isle of Wight)."

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

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FRIDAY, DECEMBER 7, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 10, 8 p.m. (Cantor Lecture.) A. D. HALL, M.A., "Artificial Fertilisers: their Nature and Functions." (Lecture IV.)

WEDNESDAY, DECEMBER 12, 8 p.m. (Ordinary Meeting.) CECIL H. HOOPER, "Fruit Growing and the Protection of Birds."

THURSDAY, DECEMBER 13, 4.30 p.m. (Indian Section.) A. YUSUF ALI, M.A., LL.M. (Cantab.), I.C.S., "The Indian Mohammedans: their Past, Present, and Future."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 3rd inst., Mr. A. D. HALL, Director of the Lawes Agricultural Trust, delivered the third lecture of his course on "Artificial Fertilisers: their Nature and Functions."

The lectures will be published in the *Journal* during the Christmas recess.

COLONIAL SECTION.

Tuesday afternoon, December 4th; the RIGHT HON. VISCOUNT MILNER, G.C.B., G.C.M.G., in the chair. The paper read was "The Cape to Cairo Railway," by SIR LEWIS MICHELL, late Member of the Cape Ministry.

The paper and discussion will be published in a future number of the *Journal.*

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready and can be obtained by members on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

THIRD ORDINARY MEETING.

Wednesday, December 5th, 1906: Sir DAVID GILL, K.C.B., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Brookesmith, Frank, Dalrymple-road, Appleby, Invercargill, New Zealand.
Faulkner, P. Leo, A.S.P., Shillong, Assam, India.
Horsley, Gerald Calcott, F.R.I.B.A., 2, Gray's Inn-square, W.C.
Rouse, Herbert James, c/o. Messrs. Mackinnon, Mackenzie & Co., Ltd., Strand-road, Calcutta, India.
Wood, Thomas Alexander Stephen, Penshurst, Prince of Wales-road, Carshalton, Surrey.

The following candidates were ballotted for and duly elected members of the Society:—

Adams, Miss Katharine, Eadburgha Bindery, Broadway R.S.O., Worcestershire.
Addis, Frederick Henry, Assoc.M.Inst.C.E., B.B. and C.I. Railway, Mhow, Central India.
Akimoto, Viscount, 6 Kita Koga-cho, Surugadai, Tokyo, Japan.
Araki, Professor Kwampo, 3 Nishimachi, Shitaya, Tokyo, Japan.
Armstrong, Miss Carr, R.M.S., 76, Longridge-road-mansion, Earl's-court, S.W.
Asano, Sōichiro, 18, Kitashinbori-cho, Nihonbashi-ku, Tokyo, Japan.
Baillie, Mrs. A. H. Murray, 94, Eaton-place, S.W.
Baxter, Walter Stephen, 38, Mayflower-road, Clapham, S.W.
Beatson, E. B., Vicarsgrange, Eastbourne.
Bebianno, Domingos Alves, care of Mark Sutton, 130*a*, Rua Barão de Mesquita, Andarahy Grande, Rio de Janeiro, Brazil, South America.
Beech, Ernest William, 32, Lincoln-road, Peterborough.
Bisset, William Molteno, Colonial Mutual-buildings, Adderley-street, Cape Town, South Africa.
Blount, Lady E. A. M., F.R.S.L., 73, West-street, Brighton.

Bonner, Albert Edward, 18, Holland-street, Kensington, W.
Bonnor, John H. M., 10, Trafalgar Studios, Manresa-road, Chelsea, S.W.
Boright, Sherman H., Forbes Reef, Swazieland, South Africa.
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Brown, Miss Charlotte, 115, Gloucester-road, S.W.
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The paper read was–

SOME OBJECTIONS TO THE COMPULSORY INTRODUCTION OF THE METRIC SYSTEM.

By Colonel Sir C. M. Watson, K.C.M.G., C.B., R.E.

Certain persons are keen advocates of the metric system of weights and measures, and desire that a law should be enacted by Parliament to abolish British measures, and compel everyone in this country to use the French. At the present time both systems are legal in Great Britain, and everyone is free to make use of whichever suits him best. All that is insisted upon is that whoever uses the British measures must use the yard, pound, and gallon, as defined by the Act of 1878, and of which the standards are kept by the Board of Trade; while those who prefer to adopt the metre, the kilogramme, and the litre must, in this case also, use measures that are in accord with the legal standards kept by the Board of Trade.

This seems a reasonable arrangement, and one that should satisfy everybody, but it is not enough for the advocates of the metric system, who want not only to use the metric measures themselves, but to force others to do so also. As they push their views with great vigour, and as the majority of those who are content with the British measures care little about the question, one hears much of the arguments in favour of the metric system and very little of the arguments against it. It, therefore, seems desirable to state briefly, for the information of those who are interested in the subject, but have not had the opportunity of studying it, some of the reasons against the compulsory introduction of the metric measures.

The arguments usually brought forward in favour of the French measures may be summarised as follows:—

1. That the metric measures are thoroughly scientific, while the British measures are antiquated and unscientific.

2. That the metric measures are better suited both for ordinary and scientific use than the British, and that the decimal system of division is superior to the binary or to the duodecimal.

3. That the metric system has been fully adopted by most nations, and, therefore, its use would be very advantageous for British commerce.

With reference to the first of these arguments, it is necessary to give a brief *résumé* of the history of the metric system.

Prior to the French Revolution of 1792 the French measures were in an unsatisfactory condition. Although the Paris toise of six Paris feet, and the aune or ell of about 44 Paris inches were the legal measures of length, different measures were used in other parts of France. The measures of weight and capacity also varied from the legal Paris standards. From time to time, under the French kings, attempts had been made to introduce a uniform system of weights and measures, but without success.

In 1670, Gabriel Mouton, an ecclesiastic, of Lyons, proposed that the standard measure of length should be based on the length of a great circle of the earth; and, in 1671, Picard suggested that the length of a pendulum, beating seconds, should be adopted as the standard, the third part of this being made the universal foot. Nothing was done for more than a century, but, in 1790, a decree was passed by the French National Assembly, by which it was enacted that a system of measures was to be adopted, based on the length of the seconds pendulum. There was much to be said in favour of this. As the length of the seconds pendulum at Paris was 3·05936 Paris feet, the new universal French foot would have been

1·01978 Paris foot, so that the change from the existing legal standard would have been small. The question was referred to the Academy of Sciences for consideration. In the first report, dated October 27th, 1790, it was recommended that the decimal system of division should be adopted, and, in the second report, dated March 19th, 1791, it was proposed that the seconds pendulum should *not* be taken as the unit of length, because "it would depend on the adoption of an entirely arbitrary unit, *i.e.*, the second of time, and it would bring in questions of atmospheric pressure and the force of gravity, which have nothing to do with the unit of length." The Commission were of opinion that it was more natural to take a measure of the earth as a basis, and recommended the adoption of a quarter of a meridian, measured from the North Pole to the Equator, as the foundation of the new system. One ten millionth part of the quadrant was to be taken as the ordinary standard of length. This was arrived at by dividing the circle into 400° instead of 360°, the division which has been used from remote antiquity. Each of the new degrees was to be divided into 100 minutes, and each minute into 100 seconds. The tenth part of a second was to be the ordinary standard of length. This division of the circle into 400° is an essential part of the metric system, though it is conveniently overlooked by its advocates at the present time.

The Commission further recommended that an arc of the meridian from Dunkirk to Barcelona should be measured with the greatest accuracy, in order to ensure that the length of the metre, the standard of length, should be absolutely correct.

The report of the Academy was received by the National Assembly on March 26th, 1791, and on the 30th of March—four days afterwards—a decree was passed adopting the quadrant of the meridian as the base of the new system of measures, and ordering the immediate measurement of the arc from Dunkirk to Barcelona. On April 13th, 1791, commissions were appointed to carry out the necessary surveys and calculations. Such was the indecent haste with which the National Assembly adopted the project for upsetting all the existing weights and measures in France.

In the following year the great revolution took place. The monarchy was abolished, the National Convention took the place of the Legislative Assembly, and the Republic was proclaimed in September, 1792.

One of the great objects of the Republicans was to destroy the records of the past, and there can be no question but that this was one of the main reasons for the adoption of the metric system. They were so anxious to do away with the old measures at once that they could not wait until the arc of the meridian had been surveyed, and the true length of the metre ascertained, but fixed it provisionally as equal to 36 Paris inches and 11·442 lines, *i.e.*, 3·07946 Paris feet.

On August 1st, 1793, a decree was passed by the National Convention, in which it was enacted that the new system of weights and measures was to be the only one to be used in the Republic. The time when this was to become obligatory was fixed at one year from the date of publication of the decree. The names of the new measures were quite different in many respects to those afterwards adopted. For example, the kilometre was called "millaire," the litre, "pinte," and the kilogramme, "grave."

This decree was followed by others. The Christian era was abolished, and replaced by the Republican calendar, the first day of which was September 22nd, 1792. The months were altered; the week was divided into ten days, and the day into ten hours, so as to be in accord with the decimal system. The circle was divided into 400° instead of 360°, in accordance with the arrangement I have already referred to. Unfortunately the heavenly bodies continued to move as before, which caused a blot on the system, as the year should have been 400 days, and the lunar month forty days. Under the actual circumstances the Republicans had to be content with twelve months in the year, and three weeks in the month.

As the circle was divided into 400°, the division of the day into 10 hours was essential. In the operation of astronomy and navigation, it is constantly necessary to convert time into arc and *vice versâ*. With the circle divided into 360°, and the day into 24 hours, an hour of time is equivalent to 15° of arc; with the circle divided into 400° and the day into 10 hours, an hour is equivalent to 40° of arc; but with the circle divided into 400° and the day into 24 hours, the hour and degree have no simple relation to one another. Even the Republican Government were not strong enough to force the ten-hour day on France, and it only lasted a year and a half. The division of the circle into 400° has practically never been adopted, and French navigators still use the circle of 360° and the geographical

mile of one-sixtieth of a degree, instead of the kilometre, which was to be the geographical mile of the new scientific system. The metric system has therefore failed to meet the requirements of navigation.

The Republican calendar and the week of 10 days lasted a little longer than the day of 10 hours, but these also were abolished by a decree issued in 1805, and the attempt to apply the decimal system to the division of time came to an end.

That the main object of the adoption of the metric system in France was not so much the introduction of a scientific system as the obliteration of the records of the past, is abundantly clear from various reports upon the subject.

For example, in an address presented to the National Convention by the Commission of Weights and Measures on January 19th, 1794, the following paragraph appears:—

"To obtain this latter result (*i.e.*, the exact determination of the length of a quadrant of the meridian) the members of the Commission are engaged in measuring the length of an arc of the meridian between Barcelona and Dune-Libre.* But while they are completing the measure, and fixing, with an accuracy hitherto unknown to the nations of the world, the exact unit which will be embodied in the standards that are to serve as types and to be kept by the National Convention, we have considered it indispensable to find immediate means of distributing the new weights and measures to the whole Republic. Soon this benefit will be extended to all citizens. Soon their eyes will no longer be shocked by those ancient weights and measures which still call to mind the odious remembrance of times and things soiled by tyrants. Republican weights and measures must necessarily take the place of the ancient ones."

Again, in a report to the Convention by C. A. Prieur, on March 1st, 1795, we find the following remarks;—

"The unity of the Republic demands that there shall be unity in weights, as there is unity in money, unity in language, unity in legislation, unity in government, and unity of interest to defend ourselves against the attack of our enemies, and advance toward all kinds of prosperity. How can the friends of equality endure an inconvenient system of measures which keep up the memory of the shameful feudal slavery? Is it not a contradiction for republicans to measure their fields by the royal arpent, or to use a royal toise or a royal foot, when they have sworn to execrate every denomination of tyranny, whatever it may be."

On the receipt of this report by the National Convention a decree was passed on April 7th, 1795, enumerating the new standards. These were as follows:—

1. The "metre," the standard of length, equal to one ten-millionth part of a quadrant of the meridian, between the North Pole and Equator.

2. The "are," the standard of surface, equal to a square of ten metres side.

3. The "stère," the standard of volume, equal to a cubic metre.

4. The "litre," the standard of capacity, equal to the cube of the tenth part of a metre.

5. The "gramme," the standard of weight, equal to the weight of a volume of pure water at the temperature of melting ice, contained in a cube of the hundredth part of a metre.

The decree ordered the new standards to be prepared as quickly as possible and distributed throughout the country. But four years more elapsed before the scientific men who were engaged on the work of measuring the arc of the meridian had completed their labours. The manner in which the operations were conducted is worthy of the highest praise, and, owing to the disturbed state of France, the difficulties were very great. Delambre, who had charge of the northern portion of the arc, extending from Dunkirk to Rodez, was constantly opposed by the people, notwithstanding the passports given him by the National Convention, and Mechain, who measured the southern part of the arc, from Rodez to Barcelona, also met with opposition, and had the misfortune to be incapacitated for a time by a serious accident, from which he never completely recovered.

It was not until April 30th, 1799, that the geodetical operations were completed, the calculations made, and the final Report prepared. The result was, that the length of the quadrant of the meridian was calculated as equal to 5,130,740 Paris toises, of which the $\frac{1}{10000000}$th part was of 36 Paris inches and 11·296 lines, equal to 3·0785 Paris feet. On May 30th, 1799, the Commission appointed to fix the kilogramme reported that a cubic decimetre of pure water at maximum density weighed 18,827·15 French grains. Platinum standard measures of the metre and kilogramme were made in accordance with these determinations, presented to the Legislative Assembly, and finally deposited in the Archives on June 22nd, 1799. These standards remain the standards of French measures to the present day.

Unfortunately, notwithstanding the care taken by Delambre and Mechain, their results

* The name of Dunkirk appears to have been changed to Dune-Libre to suit republican ideas.

were not absolutely correct, and, in consequence, the metre, as determined by them, is a little less than the $\frac{1}{10000000}$th part of a quadrant of the meridian. Colonel A. B. Clarke, C.B., in his work entitled "Geodesy," has give the length of the true metre as equal to 39·37779 British inches.

The following is a comparison of the values:—

	British Inches.
Provisional metre of 1793	39·382134
Definitive metre of 1799	39·370113
True metre (Clarke)	39·377790

On December 10th, 1799, a decree was passed abolishing the provisional metre, and fixing the length of the metre and weight of the kilogramme in accordance with the standards deposited in the Archives. Steps were then taken to make copies of the standards and distribute them throughout France.

When the International Commission on the metre met in Paris, in 1870, it was decided not to attempt to construct a metre more theoretically correct, but to take as the basis the standard metre constructed in 1799. The same course was taken with regard to the kilogramme. Careful investigation showed that the weight of the standard kilogramme of 1799 was slightly greater than that of a cubic decimetre of pure water at its maximum density; but, having regard to the difficulty that would be caused by a change in the weight of the kilogramme, it was decided to adhere to the standard of 1799, and to make the litre of such a capacity as to contain a volume of pure water exactly equal in weight to the standard kilogramme. This was an important decision, as it made the litre depend on the standard of weight, instead of the litre and kilogramme depending, as originally proposed, on the standard of length.

The following is a *résumé* of the metric system as originally designed and as it actually exists:—

Original Metric System.	*Actual Metric System.*
1. The circle to be divided into 400°; each degree into 100′; each minute into 100″.	1. The ancient division of the circle into 360° remains; each degree being divided into 60′, and each minnte into 60″.
2. The Metre, the standard of length, was to be exactly $\frac{1}{10000000}$th of a quadrant of the earth's surface, measured from the North Pole to the Equator—*i.e.*, 1-10th of a new second of arc.	2. The Standard Metre is slightly less than $\frac{1}{10000000}$th of the quadrant, and is, therefore, an arbitrary measure.
3. The Litre, the standard of capacity, was to be exactly equal to the cube of the tenth part of the Metre.	3. The actual Litre is the volume occupied by the quantity of pure water which weighs exactly 1,000 Grammes. It is slightly larger than a cubic decimètre.
4. The Gramme, the standard of weight, was to be exactly equal to the weight of a volume of pure water, contained in the cube of the hundredth part of the Metre. The kilogramme, or 1,000 grammes, was consequently to be the weight of the volume of pure water contained in the litre.	4. The Kilogramme, the actual standard of weight, is a platinum weight which was deposited in the Archives in 1799. It is slightly larger than the theoretical kilogramme, and is consequently an arbitrary measure. The actual gramme is the thousandth part of a kilogramme.
5. The Are, or standard of surface, was to be the square of ten metres.	5. As the actual Metre is slightly shorter than the true Metre, so the Are is slightly smaller than the true theoretical Are.

It will be seen from the above that all the metric measures differ from their true theoretical values, and depend upon two arbitrary measures, the standard metre and the standard kilogramme, exactly in the same way as the British measures depend upon two arbitrary measures, the standard yard and the standard pound. It is clear, therefore, that the metric standards cannot be regarded as perfectly scientific, or, as superior, in this respect, to the British standards.

When these facts are pointed out to an advocate for the compulsory introduction of the metric system into England, the usual reply is, that, at all events, the standards are nearly what they profess to be, and that, in any case, the measures in themselves are better than the British, and that the decimal system of division is very superior to the binary or duodecimal. These points deserve careful consideration. The British measures are founded on natural units, and have descended to us from a remote antiquity. The yard is the direct representative of what was probably the oldest measure in the world, *i.e.*, the cubit, which is the length of the forearm of a man of average stature, measured from the elbow to the top of the middle finger. A yard is two cubits. It is rather remarkable, that, while in the case of the yard, the derivation from the cubit is almost forgotten, the Indian "gaz," which is equal to the yard, is still divided into two "haths" or cubits. The foot is also a very ancient measure,

and though it varied considerably in different countries, it was usually about two-thirds of a cubit. The British yard is divided into three feet, or thirty-six inches. This number is divisible by 2, 3, 4, 6, 9, 12, and 18. The metre on the contrary is divided into ten decimetres, each decimetre into ten centimetres, the latter being the nearest unit to the inch. There is no division of the metre corresponding to the foot. The decimetre is too small to take the place of the foot as a unit, and it is little used. The absence of a unit of about the length of a foot is a blot on the metric system. Similarly, the inch is a better unit for ordinary purposes than the centimetre, which is too short, about four-tenths of an inch. The $\frac{1}{100}$th inch is better than the millimetre, as it is the smallest measure that can be seen conveniently with the naked eye, while the millimetre is too long.

As regards the decimal system of division, this is not a monopoly of French measures, and the British measures can be so divided by anyone who chooses to do so. But whereas in the French system, the decimal division only can be employed, in the British other fractional divisions are also applicable. For example, a carpenter prefers to use the inch divided into eighths and sixteenths, whereas for scientific and other accurate measurements, it is better to divide the inch into tenths, hundredths, and thousandths.

The pound is also an ancient measure, which has been used by many nations. It is certainly more convenient as a unit than the kilogramme, which is too heavy. Similarly the gramme is too heavy for ordinary purposes, and is not so good a unit as the British grain. But, on the other hand, the gramme is too small as the primary unit of weight, and its place as such in the metric system has been taken by the kilogramme. For use in ordinary life, the binary system of dividing weights has great advantages, although, for scientific purposes, there is a great deal to be said in favour of the decimal division. It is sometimes overlooked that scientific weighing and measuring is different to the weighing and measuring of every-day business. In the former, the object is usually to ascertain the size or weight of a given thing, whereas in the case of the latter, the object is to make a thing of a given size or weight. For this, the division by halves, quarters, &c., is more convenient than the decimal system.

For money, on the other hand, the decimal system has considerable advantages, because, in questions dealing with money, there is a great deal of addition to be done. If the advocates of the metric system would devote their energies to the introduction of a decimal system of coinage into this country there would be something to say in favour of it. At the same time, I doubt whether the Englishman would ever be willing either to give up either the penny or the pound, and it is evident that one or other must be sacrificed before a decimal system of coinage could be introduced.

As regards measures of capacity, I have already pointed out that, from a scientific point of view, there is nothing to choose between the British and the metric systems, as the gallon and litre, the standards of capacity, are both dependent upon the units of weight. The gallon is the volume occupied by ten pounds of pure water, while the litre is the volume occupied by one thousand grammes of pure water. But for measures of capacity, the multiplication or division by 8 (2^3) is better than the multiplication or division by 10. It is not generally realised how the British measures of capacity are related to the unit of length, but it is worth pointing out that a bushel (eight gallons) is a cylindrical measure very nearly half a yard in diameter and a quarter of a yard in depth, the gallon a similar measure, a quarter of a yard in diameter and one-eighth of a yard in depth, and so on. But in the metric system the multiples and subdivisions of measures of capacity have no convenient relation to one another as regards lineal measure.

There is one very important industry for which, judging from the practical experience of many nations, the metric system is not well adapted. I allude to the textile industries. In this case, even in France, after more than a hundred years, the metric standards have not completely replaced the old measures, notwithstanding the great efforts that have been made to force the manufacturers to give up the measures that they were accustomed to and adopt the new system. In the silk business, for example, the skeins are still based for length on the aune, and for weight on the denier. Decrees have been enacted in France from time to time ordering the application of the metric system to the textile industries, and, notwithstanding these, the present condition of affairs has been described in a recent publication ("L'Industrie Textile") by Monsieur Lamoitier, who says: "We (*i.e.*, the French) are as much in the anarchy of weights

and measures in the textile industries as at the time of the Revolution."

It is remarkable how entirely the question of the difficulty of using the metric system in textile manufactories was avoided by the House of Lords Committee who considered the Metric Measures Bill in 1904. In his evidence before this Committee Sir H. Jekyll, Assistant Secretary of the Board of Trade, said: "It is believed that the English yard is the measure by which silk and cotton are manufactured even in metric countries. It may be advisable to retain the yard as a measure for these trades." But, notwithstanding this very important statement, no evidence on the subject appears to have been called for, and no one interested in textile manufactures appears to have been examined. This was a serious omission, as these industries are a most important branch of British manufactures, and if the metric system is unsuitable for them it is a strong argument against the compulsory use of it in this country. The question of the difficulty of applying the metric system to textile manufactures is discussed fully in a paper read by Mr. F. A. Halsey before the American Society of Mechanical Engineers, New York, in December, 1902. There is also a useful paper on the subject by Mr. S. Dale, which is included in Mr. Halsey's work, "The Metric Fallacy," published at New York in 1904. These two papers should be carefully studied by those who wish to understand the question of the metric system as applied to textile industries.

There is another kind of measurement respecting which it would be extremely difficult in Great Britain to replace the British measures by the metric. This is the measurement of land. In his evidence before the House of Lords Committee, in 1904, Colonel Johnston, C.B., the Director General of the Ordnance Survey, pointed out the grave inconvenience that would be caused by the use of the metric system for land measurements, and the Committee inserted a clause in the Bill to the effect that the metric measures should not be applied to the linear or superficial measurement of land. It is not easy to understand how this was intended to work. Could it have been meant that the length of a road was to be measured by the metre, while the land alongside the road was to be measured by the yard? But if, on the other hand, the measurement of roads was to be regarded as a land measurement, it would not be logical to measure the length of railways by the kilometre. In any case it would mean having two compulsory systems of linear measurement, which would not be advisable.

As regards nomenclature, the British system has great advantages over the French. The words "mile," "chain," "yard," "foot," and "inch" are more distinctive and less likely to lead to confusion than "kilometre," "metre," "decimetre," and "centimetre." Similarly, "pint," "gallon," and "bushel" are more distinctive names than "decilitre," "litre," and "decalitre."

On the whole, it seems to me that the British measures are more convenient standards for use in ordinary life than the metric measures, while the fact that they can be used with the binary and duodecimal system of multiplication and division as well as the decimal, makes them more elastic and suitable for different purposes than the metric, to which the decimal system of division alone is applicable.

I now come to the main argument which is used by the advocates of the compulsory use of the metric system. It is well stated in a pamphlet which has recently been issued by the Decimal Association, a society which devotes much energy to making metric measures compulsory in the British Empire. In this pamphlet we find the following statement:—

"The chief reason of all is that we now make difficulties for ourselves in relation to our foreign trade with metric countries, and lose business because we do not manufacture and sell in terms of the metric system. To avoid the trouble, confusion, and expense of having one system of weights and measures for our home trade and another for our foreign trade, we should adopt the metric weights and measures for all purposes, and so place ourselves on an equal footing with our competitors.

"Our customers in the metric countries, which have a population of over 483,000,000, do not understand quotations and specifications based on British weights and measures. Often they cannot spare the time required to calculate the metric equivalents, and prefer to deal with Germans and other makers who use the metric system."

The implication made in these statements is that as metric measures are more largely used than the British measures, therefore it is the duty of Great Britain to give up her own measures and adopt the French.

But this argument is based on a fallacy, because at the present time there are a larger number of people in the world who use measures based on the British yard or foot than of those who use the metre, so that if there is any question of one measure giving way to the other, it is the metre that should give way to

the yard. The statement quoted above implies that the number of people who use the mètre is 483,000,000, but no proof is given of this, and an examination of the population of the different countries does not justify it.

In the following Table I have enumerated roughly the population of the different countries of the world, classified according to the measures commonly used :—

I.—*Countries in which the Yard is the Standard.*

	Population.
Great Britain and Dependencies	398,000,000
United States and Dependencies	91,000,000
	489,000,000

II.—*Countries in which the Metre is the Standard.*

	Population.
France and Dependencies	96,000,000
Germany and Dependencies	70,000,000
Austria-Hungary	45,500,000
Holland and Dependencies	41,500,000
Italy and Dependencies	32,500,000
Portugal and Dependencies	14,600,000
Belgium	7,000,000
Roumania	6,000,000
Sweden	5,000,000
Switzerland	3,300,000
Norway	3,000,000
Servia	2,500,000
	326,900,000

III.—*Countries which use Native Measures, in which the Metre is used to a certain extent.*

	Population.
States of South America	36,500,000
States of Central America	23,600,000
Spain	18,600,000
Denmark	2,500,000
Greece	2,400,000
Cuba	1,600,000
	85,200,000

IV.—*The Larger Countries which use their own Native Measures.*

	Population.
China	426,000,000
Russia	130,000,000
Japan	46,700,000
Turkey	24,000,000
Egypt	9,700,000
Morocco	9,400,000
Persia	7,600,000
Afghanistan	5,000,000
Abyssinia	4,000,000
	662,400,000

It will be seen that the total population of the countries which use measures based on the British yard are greater in number than those who use the metre, even assuming that all the people in the countries classified under the metre really used it. But this is far from being the case, as there is probably not one of these countries, where the old measures are not used to some extent. I have already shown that this is the case in France, where the metric system was invented, and where it has been longest in use. On the other hand, in some countries where British measures are not supposed to be used, they are actually employed to some extent. Mexico is an instance of this. In consequence of its proximity to the United States, it is natural that the United States' measures are considerably used, and these of course are the same as the British measures.

Even in the countries which use their own measures, as given in Table IV., in several cases the standards of length are approximate to the British. In Russia, for example, the imperial foot is the same as the British, and in China the *chih* and in Japan the *shaku* are almost identical with the British foot.

Without discussing whether the argument based on numbers has much weight, it is at all events reasonable to say that any such argument will be in favour of the yard, the foot, and the inch, rather than the metre, and to assert that we make difficulties for ourselves because we prefer to adhere to our own measures is unjustifiable.

As regards the argument that it is important that all nations should have the same weights and measures, it may also be said that it would be convenient if they all spoke the same language and used the same system of money. All scientific persons must know French and German, and all British merchants should know the language of the country with which they do business. But this would not be a reason for compelling the British people to give up their own language, and learn another. And it would be equally unreasonable to give great trouble as regards measures to many millions of people for the convenience of some scientific persons and of British merchants engaged in foreign trade with some countries.

It is doubtful whether the compulsory introduction of the metric system into this country would have much effect on increasing British trade. At all events it is fairly certain that such a change would be more in favour of the foreigner than of the Englishman, as it would

simplify the matter of exports to Great Britain from metric countries. But at present the French and German producers do not seem to have any difficulty in making articles for export to Great Britain, notwithstanding the difference in the system of weights and measures, nor do they appear to refuse British goods because we have not adopted the metric system.

There is, however, one matter in which British manufacturers and merchants might effect an improvement without inconveniencing anyone, and that is by printing their catalogues and trade circulars in the language of the country with which they are dealing, instead of in English. I have noticed, when travelling abroad, that while German trade catalogues are usually in the foreign language, this is frequently not the case with English catalogues. It is probable that a change in this respect would produce more effect than the compulsory introduction of the metric system into Great Britain.

It is difficult to say what proportion the advocates of the compulsory use of the metric system in this country bear to the whole population, but they are certainly a small minority. The greater part of the people appear to be satisfied with the existing measures, and have no wish for a change. It is the same in the United States, where I recently lived for some time, and took some trouble to ascertain the views of the people on the subject. There also the metric system is permissive, but the large majority continue to use the British yard and pound, and show no wish for a change, notwithstanding the zeal with which the missionaries of the metric measures preach their crusade. A few years ago, a Bill was introduced into Congress for the compulsory use of the metre, but it had to be dropped, and any future Bill will probably meet the same fate. The probability of the abolition of the existing standards in the United States is very small, and this, of course, is a strong argument against their abolition in this country, as our trade with the United States is greater than with any other foreign country. To change the measures of any nation is a matter of great difficulty, but to change the measures of the Anglo-Saxon race would probably be impossible.

As I have already pointed out, there is perfect freedom in this country for anyone who wishes to use the metric system. Why should the same freedom be denied to the great majority who are quite content with the British system? I cannot but agree with Napoleon, who is reported to have said on this subject, "It is a tormenting of the people for mere trifles."

DISCUSSION.

The CHAIRMAN stated that Lord Kelvin, who was unable to attend the meeting, owing to the state of his health, had sent him the following letter, with the request that he would read it to the meeting:—

Dear Sir David,—I am sorry I cannot be present on Wednesday evening to hear Colonel Sir Charles Watson's paper on the Metric System, of which I have read an advance printed proof with much interest, though I do not consider valid any of his objections to its compulsory use in the United Kingdom, and India and the British Colonies. I am sure his historical sketch of its origin in France will greatly interest all present at the meeting. There is one important detail in which I thoroughly agree with Sir Charles Watson—the centesimal division of the quadrant was an unwise and unfortunate proposal, which was never practically adopted. It has somewhat marred the otherwise thoroughly practical system for measurement of length which distinguished French men of science have given to the world. If they had thought of the enormous inconvenience of calling the angle of an equilateral triangle 66 degrees and two-thirds, instead of 60 degrees, as they had it of old; and if they had continued, as of old, to divide the degree into 60 minutes, we should now have our present nautical mile, and its thousandth part, the fathom, as the foundation of our whole metric system. Our nautical mile is too convenient for use at sea, and for all geographical measurements on land, to allow it to be abandoned. It remains with us, and is a monument of the one blemish on the French metric system, in all other respects so admirably useful and convenient for all measurements of length, area, volume, and weight. Sir Charles Watson tells us that "in 1670, Gabriel Mouton, an ecclesiastic of Lyons, proposed that the standard measure of length should be based on the length of a great circle of the earth." That was a very practical proposal, remarkably in contrast with suggestions made in England about 150 years later that we might found measurements of length on a diameter of the earth. We do not travel in a line through the earth's centre when we make a journey to the Antipodes; we do make all our journeys on the earths's surface, and it is very convenient to know that a quarter round the earth is ten thousand kilometres.

The fact, noticed by Sir Charles Watson as having been discovered by Colonel Clarke in his grand Geodetic work, that the metre ought to be about 1-5000th longer to fit the original French definition is interesting, but is of no practical importance. The true metre is now the length of the standard metre

constructed in Paris in 1799, and adopted by the International Commission of 1870. Many copies, thirty I believe, were made in platinum, and multitudinous verifications of their agreement with one another were made with all possible care. Two of these copies we have in England; and virtually the whole world is now supplied with exceedingly accurate copies of the standard metre; accurate enough for all practical and scientific purposes.

If every one of the existing standard metres, by some almost infinitely improbable concurrence of accidents, were destroyed, we can, for a continuance of accurate measurements in accordance with the present metric standard, fall back on the wave-length in vacuum of either of the chief constituents of sodium light, according to a brilliant idea suggested by Clerk Maxwell, about thirty years ago, and made thoroughly practical, within the last ten or fifteen years, by Michelson, in the splendid optical methods which he worked out finally in the Paris Bureau at Meudon, of the International Commission, for standards of practical and scientific measurement.—Yours truly,

(Signed) KELVIN.

The CHAIRMAN, in opening the discussion, thought the author had spent a good deal of excellent argument, and some sarcasm, in knocking to pieces a metric system which was originally set up in a hurried and imperfect manner by people only anxious to revolutionise everything. The metric system of that day was not the metric system of the scientific world of the present day. The present system had its headquarters in the International Bureau of Weights and Measures at Sevres, and was by far the most complete and scientifically accurate that existed. For example, the original platinum metre had been separately compared with each of the thirty existing copies, and they in turn had been separately inter-compared, so that the most accurate possible inter-comparison of those metres had been obtained. There was not the least doubt that, at the present moment, those metres were known to an accuracy of something like one five-millionth part of their length, an accuracy which was amply sufficient for the most extreme demands of science and supremely above all the possible requirements of ordinary practice. The author had objected to the fact that the kilogramme was not based rigorously upon the metre. It was very closely so, and would ultimately be made absolutely so rigorous by the refined methods of the International Bureau, thus nothing need be said upon the point. He desired at once to brush aside all arguments upon the acceptance or non-acceptance of a perfect method, because the international machinery already existed for a perfect system from a scientific point of view. Objections were made to the introduction of the metric system because the manufacturers of textile fabrics and the like had not adopted the system, although by law it was the only legal system in France. He was not at all sure that, if the metric system was compulsory in England, manufacturers would be obliged to employ, in the technical arts for the details of construction, threads and screws which were an exact part of a millimetre or an exact number of millimetres. They would not be required to put so many threads into the millimetre of a textile structure, but they would be compelled to sell their product by the metre. He was perfectly prepared to admit that the unfortunate fact that a man had ten fingers, including his thumbs, and this had practically compelled the world to adopt the present system of arithmetic, and that if the advice of Charles XII. had been followed and duodecimal arithmetics had been adopted, they would have had the perfection of a duodecimal system of measurement. It was now perfectly impossible to introduce duodecimal arithmetic; it was a dream of the future: and in the meantime, for the conveniences of life, they had to adopt the present system of arithmetic, and, he maintained also, the decimal system which was contained in metric measurement. He believed every country which had adopted it for sales and bargains on large scales had found it most convenient, and had certainly not given it up. The author had given the number of people in various countries who used the different systems, and had boldly put down Great Britain and its dependencies, with a population of 398 millions, as using the yard as the standard. He thought it would have been much fairer if Sir Charles had only given the figures for the intelligent white people of the Empire, who were capable of forming an opinion about standards, and, if he had done so, the people using the yard as the standard would appear in a very large minority. It must also be remembered that, whether they were in a majority or minority, they had had hundreds of years of use in which to obtain their advantage, whereas those who advocated the metre had had only a comparatively short time at their disposal in which to press their views.

Lord BELHAVEN AND STENTON stated that in 1904 he introduced a Bill in Parliament for the compulsory adoption of the metric system in four years' time, which would have given the people of the country plenty of time in which to become thoroughly acquainted with it. The Chairman was perfectly correct in saying that compulsion would go no further than insisting that the metric system should be adopted for the purchase and sale of articles which could be measured and weighed for ordinary trade, and would not interfere with screws or textile fabrics being made on any old system the manufacturers liked. The first part of the paper was taken up with an interesting review of the history of the metric system, but for all practical purposes the question was purely academic if not antiquarian. He must take objection to the author's statement that the division of the circle into 400 degrees was an essential part of the metric system, because it formed no part of the metric system which they desired to

introduce. The Chairman had so ably replied to the author's criticism with regard to the accuracy of the metre that he would not refer to that subject except to mention that it might not be generally known, as it was not known when the measurements were made from Dunkirk to Barcelona, that the earth was not a regular sphere nor even a regular oblate spheroid and owing to irregularities of land and water the distance from pole to the equator varied. He was told on very reliable authority that there was a certain meridian in the eastern portion of Asia where the distance from pole to equator would measure exactly ten million metres. That he thought quite disposed of any objection to the metre not being exactly correct, for if the meridians varied, and the metre conformed, there would be a different metre in every part of the world. Passing on to a more practical question, he would like to ask why they should cling to a yard because it was equal to two ancient cubits which must certainly have varied in countries inhabited by the tall inhabitants of Northern Europe or those of the much smaller Southern nations, to say nothing of the difference of length of the forearm in different individuals. After the extreme accuracy for which Colonel Watson had just been advocating, he thought the old cubit was rather a "come down." He could not but think that the author's views of convenience were considerably biassed by habit and custom, and a disinclination to think in any other measures than those he had always employed, and that the idea that a metre was too long and a centimetre too short for convenience would appear a most extraordinary one to a Frenchman or German who never used anything else. Similarly, Sir Charles said, an English carpenter preferred the inch divided into 8ths or 16ths, but he should be very much surprised if a German carpenter would like such measures. When the author said that 100th of an inch was better than a millimetre because it was the smallest division that could be seen by the naked eye he admitted it was a reasonable hypothesis although he did not exactly agree with him. The fact was that a millimetre, which was about 1-25th of an inch, was a larger division than that which could be clearly seen, while 100th of an inch was too small, divisions of 1-50th being as small as most people's eyes could easily mark. But in that connection everything turned upon the particular trade or business in which the scale was employed. In connection with the subject of decimal coinage to which the author had referred, the advocates of the introduction of metric weights and measures were all in favour of the decimalisation of money, but those favouring the reform were divided into two camps, the one favouring the pound as a basis and the other the penny. For the present, therefore, the question which did not affect the other was shelved; at any rate it did not affect English trade and commerce in nearly the same degree as the similarity of the weights and measures used by different countries. With regard to the tables of population given of countries using and those not using the metric system, the author had added to the latter the whole population of India. The millions of natives had their own weights and measures which had come down to them from ancient times, and on the other hand Sir Charles had omitted Japan and the South American Republics which had adopted the metric system. The author had asserted that the metric system was not well adapted to textile industries. That was an entire misconception, and if anybody was in doubt on the subject he recommended them to read a pamphlet by M. D. Chedville. In France, the system was simplicity itself. The metric system was particularly suitable to the textile industry, because by the use of a far less number of figures than were used in the English system, it was possible to find the length of yarn required, or the weight of material, in fact it was so simple that it hardly required any calculation at all. The same counts of yarn were not used all over England, different counties having different systems, for instance, three different systems prevailing in Yorkshire, Aberdeen, and Halifax. An International Congress was held in Paris, in 1900, on the unification of the counts of yarn, and it was there decided that the metric system should be adopted, but England could not take advantage of the decision so long as its antiquated weights and measures were retained. The author had also raised the question of the measurement of land. A great expense would be incurred in completing all the ordnance surveys of 1 inch or 6 inches to the mile, to a metrical division of 1 by 50,000, but that was the only objection. Some time ago the Ordnance Survey commenced a decimal system, because the whole of the towns were now surveyed, printed, and mapped out on a scale of 1 in 500, whilst the whole of Great Britain had long since been mapped out on a scale of 1 in 2,500. It was therefore only necessary to put the metre scale upon that and read the number of metres upon it with an ordinary metre scale used by a Frenchman or a German. If the map were reduced by photography to 1 in 50,000 the map of England would be of the same scale as that of France, Germany, and Switzerland. He did not think the author could have seen the consuls' reports which were sent home to this country year after year saying that trade was being lost by the manufacturers of this country because when people abroad desired to purchase an article they could not understand English weights and measures. One or two points were entirely left out of the paper, particularly the education of the child. One point which they claimed as an advantage for the metric system was that a child should not have to spend one, two, or even three years in learning tables which he forgot immediately afterwards, but that a simple system of weights and measures should be adopted so that he would no longer have to learn compound multiplication, compound division, compound addition, and that terrible thing called practice.

All those things would disappear, and the work of taking out the prices of any quantity of things in length and weight would be done in a moment without any compound rules. Another important consideration was the question of calculations in ordinary life. The engineer felt the disadvantage most, because he was troubled with having to deal with such awkward figures as $30\frac{1}{4}$ square yards in a pole, and many other difficulties, whereas a cubic centimetre of water weighed 1 gramme, a cubic decimetre of water weighed 1 kilogramme, and a cubic metre of water weighed one metric ton, and given the specific gravity of any substance it was only necessary to multiply the capacity by the specific gravity to obtain the weight. When he introduced his Bill in 1904 he presented an enormous number of petitions, and when he moved the third reading he summed them up as follows:—"The town, city, and county councils which presented petitions represent a population of eight millions; 50 chambers of commerce have petitioned, as well as 42 trades unions, representing 300,000 members; 60 teachers' associations, inspectors of weights and measures in 80 districts, and 30 retail trades associations." Finally, it might be of interest if he stated that they were promised the support of 400 members of the House of Commons in the present Parliament whenever a Bill was introduced.

Mr. THOMAS PARKER stated that at one time he had the metric craze and advocated the use of the metric system, but after carefully studying the subject he discovered it was a delusion and a mistake. It was absolutely untrue to say that British measures could not be scientifically used. The inch, the square inch, and the cubic inch had been in use practically for all time, the only difficulty that had arisen being that there was no unit of weight based upon the linear measure of the inch. If a cubic inch of water was adopted as the unit of weight, a much better measure would be obtained than the metre.

Mr. ALEXANDER SIEMENS stated that the commencement of the author's paper reminded him of the old story of the solicitor, who, in instructing counsel, said there was no case, and, therefore, he was to abuse the plaintiff's attorney. Sir Charles absolutely ignored the fact which he (Mr. Siemens) brought forward some years ago, that the metrical system really originated with James Watt, who said that any rational person would see that the decimal division was the proper thing to adopt. Professor Smith, of Birmingham, put it in a different way when he said that the system of weights and measures ought to be systematised on one basis of ratios throughout. That embodied the great advantage of the metric system. The second condition was that the basis ratio must be 10, because all arithmetic was based on 10. A great deal had been heard of the good old English weights and measures, but in his opinion that was a fallacy. Up to 1824 the pound avoirdupois, which had been used since time immemorial, was not legal. It was casually mentioned in the Weights and Measures Acts of 1760 that it was 7,008 grains, but in 1824 that was altered to 7,000 grains, while the Act contained in its preamble words to the effect that, owing to the chaotic state in which the weights and measures of Great Britain were, some imperial measures must now be created. Even the Act of 1824 did not accomplish everything, because it allowed heap measures in bushels, and the present system was really introduced in 1834. It was not the fact, as had been stated, that the United States were using exactly the same measures as England, and they ought therefore not to be ranged together. The Parliamentary Committee appointed in 1861, stated in their Report that it was no use to try to introduce a purely British system, because in a few years the country would be compelled to adopt an international system, and two changes would then be made instead of one. Even if he were prepared to say (which he was not) that the inch was better than the centimetre, it was impossible now-a-days. The German Customs Union appointed a committee in 1861 with orders to invent a national German system, but soon after commencing their labours they reported that it was an impossible task, because it was certain that with all the means of inter-communication between various countries, an international system must be adopted. In that respect only two systems could be considered, the English system and the French system, the latter of which had a systematised base ratio of 10 all through, while the former had all sorts of ratios. A good deal had been said about the duodecimal system, but the division was not duodecimal. For instance, he would like to know how many ounces there were in the third of a pound. The question of the compulsory introduction of the metric system reminded him of a very shrewd remark made by an Inspector of Weights and Measures, who was against compulsion because if shopkeepers had two sets of weights and measures on the counter they would know perfectly well what would happen to the unwary customer. The great stalking-horse trotted out against the metric system was the textile industry. He remembered that, when giving evidence before the Select Committee on Weights and Measures in 1895, he was asked the following question by Mr. Whiteley:—"Taking the cotton trade, a standard make is what is called 79 inch $37\frac{1}{2}$ yards $8\frac{1}{4}$ lbs. shirting, which is known all over the world wherever that shirting goes at the present time. It is known as of certain weight, length, and width; would it not in some way damage the reputation of that shirting if those figures had to be re-calculated in all the markets of the world?" He was sorry to say he was taken aback at the time, and made an answer which was not worth reproducing. But subsequently he turned the figures into metric measures, and found that the 79 inches were 2·066 metres, the $37\frac{1}{2}$ yards were 34·3 metres, and the $8\frac{1}{4}$ lbs were 3·75 kilogrammes;

so that the textile industry were practically using metric measures only they did not call them so.

Mr. GEORGE MOORE, in referring to the textile industry in Lancashire, said he did not know a single manufacturer or spinner who wanted, or who used the metric system; but he knew there were a few merchants in this country, who did not weave or spin, but who imported European yarns into this country, and agitated for Parliament to make the metric system compulsory, so that German and French yarns could be introduced into England, whereas Lancashire people wanted to sell Lancashire cloth and yarn out of the country. Lord Belhaven had stated that an International Conference was held in Paris in 1900 for the purpose of simplifying the number of yarns, but he did not state that it was the fifth International Conference which had met since 1870, and that the Conferences had come to five different decisions. At the present time the English system of textile numbering was universal. One of the greatest arguments used by the advocates of the metric system was that an international system was required; they had it in the textile industry. He had been to the United States twice during the present year to examine the question of weights and measures reform as between England and the United States, and was therefore exceedingly surprised to hear Mr. Siemens state that the same measures were not used in this country as were used in the United States. The only different measure in use in America compared with England was the measure of capacity, the Americans still using the old ancient Anne gallon, which England discarded nearly 100 years ago. Mr. Siemens had also stated that James Watt conceived the idea of the metric system, and was in favour of its use. James Watt was in favour of the metric system, but was strongly opposed to the metre. A good deal had been said to the effect that, once people used the metric system, they never gave it up. During the last few years Messrs. Willans and Robinson, of Rugby, had been held up as the leading firm of manufacturers in this country using the metric system, whose example should be copied by the other manufacturers of the United Kingdom. He had received a letter from that firm, dated November 27th, 1906, stating that they would be glad to join the British Weights and Measures Association with the object of assisting in the fight they were making against the compulsory introduction of the metric system into this country. They were satisfied, after a long practical trial, that such advantages as were to be obtained by the use of the metric system in an English machine-shop were too dearly purchased. In the ordinary way they were making new lines of work to English dimensions, and were satisfied that the adoption of the metric system had cost them a great deal in gauges and special tools without affording an adequate return. Messrs. Sellars and Co., the Whitworths of America, after giving the metric system a thorough trial had also come to the same conclusion and were strong supporters of the British Weights and Measures Association, which had for its object strenuous opposition to the compulsory adoption of the metric system.

Dr. FREDERICK ROSE stated that one objection made to the metric system was that the multiplicity of new terms would prove very confusing. Germany had used the metric system for forty-three years, and, as a matter of fact, only a few terms were used. In the measures of length, only the metre, the centimetre, and the millimetre were practically used, the further sub-divisions above or below being scarcely ever used. In capacity, the principal measures were the litre and hectolitre, and for the subdivisions below it was only necessary to say half litre or quarter litre. It was most remarkable that in many parts of Germany the old local names for measures were still retained, when a pound of goods were asked for, 500 grammes being given, and so forth. He also took exception to the way in which the tables of population in favour of the British measures had been tabulated. Looking at the question from an educational point of view, in his opinion the children in the elementary schools of the country were handicapped by having to learn the unfortunate system of weights and measures in vogue, and were behind, compared with the children of other nations, one or one and a-half years in their education.

Major E. H. HILLS, R.E., C.B., remarked that advocates of the metric system in the course of their arguments lapsed almost insensibly into an argument in favour of the decimal system. The author had quite rightly pointed out that the two should be most rigorously distinguished. Almost all the arguments which had been used in the course of the discussion in favour of the metric system, were equally capable of being applied in favour of the introduction of a decimal system based on the English weights and measures. The only argument which remained was that of uniformity with the rest of the world. For instance, the argument used with regard to the waste of a child's time in education, had nothing to do with whether the child learned metres or yards as the unit; it had to do with our complicated system of weights and measures, which they were not concerned to defend in all particulars. He thought the argument in favour of the present free system, where everybody was allowed to use those weights and divisions which most suited their particular trade, was the best for a free country. For scientific purposes, there was no doubt that the decimal metric systems presented very great advantages. If the textile industry was against the change that was quite enough to render it altogether out of the question, because one-sixth of the population of England depended for their livelihood upon that trade; and even supposing it were desirable on other grounds such a change could not be arrived at in the face of the determined and united opposition of so large a proportion of the population and wealth of the country.

Mr. EMERSON DOWSON did not think sufficient attention had been given to the evidence given by Sir Robert Giffen before the Select Committee in 1905 as to the enormous extent of English foreign trade with countries using metric weights and measures. Sir Robert gave it as his deliberate opinion that great loss was suffered by the traders of this country on that account. He thought the comparisons of population which had been given were misleading, and considered it would have been a fairer method to adopt if the figures had been based on the trade that was done with the various countries enumerated.

Mr. R. K. GRAY said the assumption was often made that only the metric system was used in France and other countries. He was the managing director of a company employing 900 men in France and about 3,000 in England, and from personal experience he would like to state in the most positive manner that it was a great mistake for any Englishman to believe that the metric system was solely employed in France. For instance, if anyone went to the market-place he purchased things by the litre; but wine was sold by "le barrique" (225 litres); "le feuillette" (134 litres), "le demi setier" (¼ litre), and "le chopine" (½ litre). People who were not accustomed to the terms of the country did not know what they meant. The old term of the barrel was still used because the barrel was the most useful size for the trade in wine. The same remarks applied even to Government departments. He remembered asking a clerk in the Post-office how much a registered letter would cost, and received the reply—"Fifteen," meaning fifteen sous. The proper answer for the clerk to have given, would have been 75 centimes, but he talked in sous, because it was far more convenient. In the practical application of the measures in France, the people could not detach themselves at all from the natural selection of the proper measures for certain trades. If what he said was correct, why should the people of England make compulsory measures which, in the country of their origin, were not actually in use to-day in common life, although it was 112 years ago since they were inaugurated?

Sir CHARLES WATSON, in reply, said the statement had been made that, in the education of children a great deal of time was wasted in teaching them weights and messures. An American had very carefully taken out from the school schedules in the United States the exact time that was devoted to weights and measures, and found that in a school curriculum of eight years, 6 8-10ths weeks were devoted to the subject, and thereupon said he could not understand how, out of seven weeks, a year could be saved in the education of a child. The measures in the United States were exactly the same as in England with the exception of the gallon. In former times, two gallons were used in England, one for dry measure and another for liquid measure. England retained the dry measure gallon and made that her sole standard, while America adopted the liquid measure as her standard.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Sir Charles Watson for his interesting paper, and the proceedings terminated.

Mr. W. TERTIUS ROWLETT (Leicester) writes:—I am sorry that the lateness of the hour prevented me from taking part in the discussion on the metric system last evening, and shall be obliged if you will allow what I had to say to appear in the *Journal.*

The meeting in 1900, at Paris, of the International Association for the Unification of Yarn numbers, was alluded to by some of the speakers. I am a member of the permanent committee of that Association, and took an active part in the meeting at Paris. The decision was in favour of the metric numbers of 1,000 metres per kilogramme and per number, and the general opinion was that the only hindrance to its adoption was the abstention of Great Britain and America. I advocated that, by way of preparation, every spinner should put the metric number by the side of his own special number on every ticket and invoice; because during forty years' experience I have never found a foreign spinner who did not understand metric counts, whilst most British spinners were ignorant of them. The author spoke of the textile industries, and especially the silk trade, as not having adopted this system; but he was apparently unaware that the British Silk Association, in 1902, joined with all other countries in accepting the international numbering of 1,000 metres per kilo and per number for silk yarns, and added to the convention many suggestions that, when other numberings were used, their metric equivalent should appear also.

The gentleman who spoke on behalf of the cotton trade stated that all the textile traders of this country were opposed to the adoption of the metric system; but this is a mistake, as he is only entitled to speak for the cotton branch. Many of the other branches would welcome the change, as it would obviate the necessity of making goods to two different standards, and allow articles to be used for export without having to be made specially.

It seems somewhat singular that the cotton trade, which uses decimal calculations more than any other branch, should object to the introduction of the metric system, but they give the following reasons:—

Many say their numbers are so well known throughout the world that there is an advantage to keep them; they further say it is impossible to spin metric counts on their machines; but this is quite erroneous. It is absolutely impossible for anyone, even with the very best machinery, to spin exactly to the count required, and therefore a variation of ¼ number above or below the count is accepted. This makes a variation of half a number, which is a much greater difference

than would be necessary in transferring Manchester counts into metric ones. In some cases the existing numbers have almost their exact equivalent in metric sizes; for instance the Manchester

No. 10 = 16·928 metric,	say 17,	a variation of	0·072.
No. 13 = 22·007	,, 22,	,,	0·007.
No. 16 = 27·072	,, 27,	,,	0·028.
No. 18 = 30·471	,, 30½,	,,	0·029.
No. 19½ = 33·011	,, 33,	,,	0·011.

As to the advantage they gain, the foreigner is verging more and more towards the metric numbers. In the present year, I was speaking to a German cotton spinner about English numbers; he did not understand them, but when I mentioned metric sizes, he knew at once. The only change necessary for a cotton spinner would be in reeling his hanks 1,000 metres, instead of 840 yards; or if they were found too heavy, then in half banks of 500 metres. But this would only be required for yarns in bundles, as a very large proportion of the exports are sold in cops, the form in which yarn leaves the machines.

The foreigners continue to use British cotton numbers because they buy so much British yarn, but this complicates their calculations very much when casting. The continental cotton spinners are making great strides ahead, and are principally spinning metric counts, and, other things being equal, these will be bought in preference to British yarns, so that our spinners will be likely to feel their competition strongly when the season of bad trade sets in.

With cloth the change to metric measurements is very simple, the only alteration necessary to the loom being the reed or slay, a comb through which the warp threads pass before reaching the shuttle.

The speakers who advocated the decimalization of the inch spoke for lineal measure only, and have nothing to offer in weights, or measures of capacity, with a decimal relation to the inch. The British Weights and Measures Association, which is the centre of this agitation, in order to retain the inch and pound avoirdupois, propose that the weight of a cubic inch of water should be called 1 ounce, 28 ounces would then weigh 1 pound, and 10 pounds to the gallons, but at the very outset this proposition breaks away from a decimal system. The only complete decimal system in use still remains the metre one, and the attempt to introduce any other system instead, would cause at least as much difficulty.

Mr. AUGUSTE M. THIERRY writes:—It was rather a pity that Sir Charles Watson in an otherwise excellent paper on the past history of the metric system threw cold water on a committee of savants which certainly comprised some of France's finest intellects of the time. It was natural that speakers in the National Assembly should with all their might push the new order of things, and, considering the times, there was no indecent haste in endeavouring to replace the chaotic system of measures of an infamous past.

The author referred several times to the decimal division being the only one applicable to the metric system, but this is not so, for ½'s, ¼'s, ⅛ths, $\frac{1}{16}$ths can be just as easily employed, and in fact are so. Then as to the cubing of 8 being easier than that of 10. Surely this is an error of the author, for nothing could be easier than tens to deal with in this connection.

It was mentioned by Sir Charles that none of his metric friends could give him "the cube or capacity of an hectolitre." I am sorry, for a simple calculation reveals it at once:—

Cubic metre = 1,000 litres.
Hectolitre = 100 do.

therefore the capacity of the hectolitre is the 10th part of a cubic metre or 100 cubic decimetres.

He said the prefixes deca, hecto, kilo, could be mixed up with deci, centi, milli; I can only say that such mistakes are next to impossible, for the former refer to multiples (units), the latter to submultiples (fractions).

I cannot admit that the gain would be all in favour of the foreigner when the change comes; the immense advantage to ourselves is inconceivable for the majority, and hence the antagonism. I venture to say that not twenty in this room use decimal fractions for their computations, and it is only among those that the full understanding of the advantages of the metric system can be self-evident. This is the reason why the permissive act in favour of the metric system is useless; it is a case of the educated minds —a minority—forcing a majority for its ultimate good.

The inch as a unit is utterly impossible, for where are the stepping stones upwards, the multiples 10 inches, 100 inches, 1,000 inches; fancy stating the distance to Land's End in inches! no, this is conservatism walking backwards.

Mr. R. K. Gray referred to old French names of measures being used to this day in France, thereby leading one to infer that the metric system was ignored there in many places, but he did not say that the old names applied to the new measures, and therefore they did not in any way destroy the value of the existing metric system there.

Mr. BENNETT H. BROUGH writes to supplement Mr. Gray's remarks on the persistency of the old units in France, by directing attention to the official circular recently issued by the French Minister of Commerce, a translation of which appeared in the current issue of the *Engineering Magazine* (p. 268). It showed that the penalties imposed by the Act of 1837 had not proved sufficient to prevent the use of the old units, and contained a pathetic appeal that metric units should be used. In Great Britain, where the use of the metric system was permitted by Act of Parliament, it seemed unsportsmanlike that the metric advocates should desire to have all who did not accept their views, fined or imprisoned. Every gaspipe would have to be torn out of our houses; all existing technical literature would be rendered useless; every retail trader would have to buy a new set of weights;

and the working man would be fined or imprisoned if he asked for the half-pint to which he was accustomed. The writer had had experience in mine surveying work in Germany, and even there old units persisted. Shafts were measured in Lachters of 6 feet; horizontal lengths were measured with centimetres on one side and, for actual use, Hanoverian feet on the other, and the compass used was graduated into 24 hours, eighths, and sixteenths of eighths, so essential for rapid work was the principle of continual bisection, which was the basis of practical geometry and of mechanical engineering practice.

TRADE WITH INDIA.

II.

EXPORTS OF INDIAN MERCHANDISE.

While imports of merchandise increased by 6·6 per cent., the value of the exported merchandise increased by only 2·66 per cent., or 410 lakhs, but this followed larger increases in past years. Indian exports consist mainly of raw agricultural products, and in these there is a continual rise and fall, following on prosperous or adverse seasons. Rice represents 63 per cent. of the total value of food grains exported from India, and 11·8 per cent. of the value of all Indian produce. In 1905-6, the total exports of rice to foreign countries receded by 13 per cent. in quantity, but only 4·9 per cent. in value, the exportable surplus of rice depending on the success or failure of other food crops throughout the country. Japan is the largest purchaser of Indian rice, Ceylon and the Straits Settlements coming next. Of the western countries, Germany would seem to be the foremost purchaser.

On the average of the last five years, the value of the wheat exported has represented 39 per cent. of the exports of all food grains, and 6·4 per cent. of the total value of all merchandise exported. The crop of 1905-06, more particularly in the United Provinces, was very seriously injured by frosts, and the effects are very clearly marked in the contraction of the exports to less than half the figure attained in the previous year. It is important to note that in 1904 India was the largest contributor to the wheat supply of the United Kingdom. But in 1905 it fell back into the third place, Russia and Argentina being first and second. The British crop, too, rose considerably in 1905. The shortage in wheat and enhancement in prices necessarily restricted the exports of wheat flour.

Passing by provisions and spices, we come to tea, a produce of special interest to us at home. The area under cultivation has almost doubled within the last quarter of a century, and the out-turn is now over 222 million lbs., 90 per cent. of this being derived from Bengal and Assam. The ascertainable production has increased much more rapidly than the area, 210 as against 85 per cent., in addition to which is to be taken into account the quantity consumed in the country itself, which is supposed to amount to 7 million pounds per annum. The quantity exported in 1905-06, about 884 lakhs of rupees in value, represents a record. From another point of view, it is interesting to note that the joint stock capital engaged in the industry amount to over 14 millions sterling, about £12,000,000 being registered in England and £2,250,000 in India. In addition to this, there is, of course, a large but unknown quantity of private capital also engaged. The labour employed is returned at 552,999 hands, or about one to the acre.

Of this considerable out-turn the United Kingdom still takes the lion's share, (whether for consumption or re-export), though the quantity exported thither (over 166 000,000 lbs.) is less than it was two years ago. On the other hand, the direct exports to Canada have developed from 3·1 to 3·6 per cent. The shipments to Russia have also developed satisfactorily, the general tendency being no doubt in the direction of direct shipments to countries formerly supplied through British ports.

Comparing the progress of the tea trade of India with that of Ceylon and China, the two other principal sources of supply, it is significant that India has increased her exports by 44 per cent. and Ceylon by 55 per cent., while China's exports of black and green tea have declined by 31 per cent., and of brick and dust by 10 per cent.

Manganese ore represents nearly 82 per cent. of the value of all exported metals and manufactures other than hardware, the balance consisting of brass, iron, and copper manufactures. The trade in manganese, which has virtually come into existence in the last ten years, received a great impulse in 1905-6, in consequence of Russian anarchy in the Caucasus and Donetz mines. The exports from India accordingly rose to 316,694 tons, an increase of over 75 per cent. At the same time the price in Europe has gone up by about 50 per cent.

Opium is a product of exceptional interest just now, and it is noteworthy that the exports of the native drug have been continuously declining during the past twenty years, from an average of about 35,000 chests in 1885 to 15,043 chests in 1905. The total value of the exports of opium, both from Bengal and Bombay, decreased by 10·8 per cent. in value, but even now it foots up to 947 lakhs of rupees, which will give an idea of the amount eventually to be made good in the Indian Budget, should the recent anti-opium edict from Peking mean "business," or have any practical effect. As to the unmanufactured tobacco exported from India, this consists largely of leaf intended for "hookah" smoking, and not for manufacturing processes. The British duty is prohibitive as regards this article. Indigo, once a flourishing industry, has decreased to a remarkable extent, as is well known, under the competition of "synthetic" indigo. The drop in value has been from 535 lakhs of rupees in 1895, to 58 lakhs last year, a decline of 89 per cent. Of course, this has been accompanied by a large corresponding decrease in the area under cultivation. Much of the ground

formerly grown with indigo has now been turned over to cotton, which offers a fairly constant market, and to sundry experimental cultures like rubber, flax, &c. Oils (animal, essential, mineral and vegetable) showed a decline during the year under review, the greatest falling off being in mineral oils.

In the group of raw materials, interest naturally attaches to coal. There are 47 companies engaged in coal-mining in India, one in Burma, and the remaining 46 in Bengal. The first coal mine in India was opened in 1820, and for twenty years this solitary mine had no competitors. But with the development of railways, and the establishment of mills and factories, the demand for Indian coal grew apace, while it is yearly taken in greater quantities by ships trading to Indian ports. The increase in output has been steady, and has risen during the past twenty years from 1,294,221 tons to 8,417,739 tons. In twelve months, there was a rise of 2·45 per cent. In 1905-6, the exports exceeded all records, in respect of both quantity and value, Ceylon and the Straits Settlements being the principal buyers.

The export trade in raw cotton is, of course, conditioned by the indigenous crop results, but is governed largely by the relation of textile activity in Europe and the United States to the supplies available in America and Egypt. In these respects, the season of 1905-6 was fairly satisfactory. The area under cotton in India has, in the last three years, increased from 16·5 million to nearly 20·5 million acres. The yield of the crop in 1904-5 had shown a substantial increase, but the crop of 1905-6 diminished by 15 per cent., the condition being specially unfavourable in the Central Province, Berar, Hyderabad, and the Punjab. The American crop was the largest known, and might have been expected to weaken Indian export prices greatly, but the general activity in the textile industries sustained the Indian values better than could have been foreseen. Japan, Belgium, and Germany are all important buyers of Indian cotton, but the increase in exports to the United Kingdom is insignificant.

Some of the most marked examples in the movement of prices in 1905-6, have been furnished by the hide and leather trades. The very great consumption of leather during the Japanese war, and the extensive employment of certain classes of goods in industries now active, have depleted stocks and raised prices 25 to 60 per cent. Although the export of both raw hides and raw skins increased largely in number, the average value of the former rose 6 per cent., while that of skins fell slightly. The value of the two together amounted to 1,011 lakhs of rupees. This represents 6·4 per cent. of the entire exports of Indian produce, and places the trade among the most important. About three-quarters of this came from Calcutta, and of that total the United States took nearly 43 per cent., or 432 lakhs worth, while Germany, Italy, Austria-Hungary, France and Spain followed. The predominance of the United States (when there has been such a shortage in leather supplies as to have created a movement for the abolition of the duties) was mainly in skins.

The exports of jute, on the average of the last three years, represent some 21·8 per cent. of the total value of Indian raw produce exported. During 1905-6 the value exceeded the previous record (that of 1904-5) by no less than 43 per cent. As to the development of the jute industry, it may be mentioned that the number of looms has increased from 6,337 in 1884, when the Indian Jute Mills Association was formed, to about 22,750 in 1906. Of the out-turn, 43½ per cent. came home to England, whence nearly half of that quantity was distributed to other parts of the world. Seeds, such as linseed, rape seed, seamum, cotton, poppy, and castor seed, represent 6·7 per cent. of the entire exports of Indian produce. In 1905-6 their value marked a decline from the very large exports of the previous years. There was an improvement during the year in the trade in all classes of raw silk, which collectively rose 32·4 per cent. in quantity and 13½ in value. A great expansion in shipbuilding and in some other branches of construction in the United Kingdom, Germany, and the United States have synchronised with a contraction in the available supplies of teak, and has induced a rise in prices, in some cases prohibitive. Exports from Burmah to India proper decreased by a further 5·9 per cent., while imports into India from Siam and Java increased by some 34·7 per cent. But practically the whole of the teak trade in the north of Siam is controlled by British companies.

In wool, the general activity of the textile trade caused a rise in the price of the raw material, and an expansion of the Indian exports. These reached 42½ million pounds in 1905-6, which marks a progressive record for the third year in succession. The United Kingdom took 200 lakhs' worth as compared with 174 lakhs in 1904-5.

In the group headed "Articles Manufactured and Partly Manufactured," the most important item is that of cotton manufactures, the exports of which showed extraordinary expansion in response to the restoration of peace in the Far East, the opening of markets rendered bare by a series of unfavourable years, and a return of prices, both of the raw material and of the finished article, to favourable levels. Yarns and piece goods attained in 1905-6 a value of 1,238 lakhs, and 186 lakhs respectively. The figures are unprecedented. Yarn represents about 85 per cent. of the total value, and has shown a substantial increase, corresponding approximately with the estimated rate of increase in the exports of cotton goods from the United Kingdom in 1905. An overwhelming proportion, 94·3 per cent. of this product goes to China; the figures for the Straits Settlements show a slight contraction, which is attributed in the report to the exceptionally healthy state of the trade, and consequent increase of shipment direct to ultimate destination. The export of piece goods increased only about 12·98 per cent., but this is due to no de-

ficiency of demand but to the incapacity of the Indian weaving mills to increase their output commensurately. Grey goods showed healthy progression, the shipments to China being particularly active. But the main markets for Indian cloth are found in East Africa, Aden, Red Sea ports, Abyssinia, the Persian Gulf, Ceylon and the Straits, while dyed and printed cloths go mainly from Madras to the two last and the Philippines. Madras also sends handkerchiefs and shawls to the diminished value of 8½ lakhs, almost wholly to the United Kingdom. In connection with this, one may note the uninterrupted increase in the output of yarn and cloth from the Indian mills, which now boast of 37,454 spindles, the great majority in Bengal. For the first time, it has been possible to compute that the capacity per spindle and loom respectively, under Indian conditions is 131 lbs. of yarn and 3,221 lbs. of cloth per annum.

Exports of jute manufactures, both bags and cloth, increased largely both in quantity and value, the aggregate production having reached a level never before attained. The shortage in the Indian wheat shipments diminished the country demand for bags, and Australasia and Chile took very large consignments, 141 lakhs and 64¼ lakhs worth respectively. In the United States there is a heavy duty on imports of made bags, but of cloth they took 419½ million yards, with a total value of 378 lakhs of rupees, making a quantitative advance of 19 per cent. on the previous year's figures.

Silk and woollen manufactures (the latter chiefly carpets and rugs) declined in value so far as exports are concerned. But the production in woollen mills in India marks a quantitative increase, indicating a strong internal demand. Tanned hides and skins, like the raw articles referred to above, shared in the activity of the leather trade, the values registered in 1905-6 being 154 and 209 lakhs of rupees respectively. The greater part of both comes to the United Kingdom, but in 1905-6 America took a considerably larger share of hides, and Great Britain's proportionate share declined. In regard to skins, the United Kingdom increased her share from 90 to 93·6 per cent., this being ascribed to the demand for motor padding and clothing.

Lac is an article much in demand for electrical and certain other industries, and during the last three years there has been a marked upward tendency both in quantity and in value exported. Shellac, buttonlac, and the raw material (stick and seed lac) have all participated in the expansion. The United States appears as the first buyer of lac from India.

Viewing, in conclusion, the general distribution of the export trade, we find of course the United Kingdom in the premier position, with 25·3 per cent., China coming second with 13½ per cent., and Germany, the United States, Japan, France, and Belgium next. Then follow the Straits Settlements, Ceylon, Italy, Austria-Hungary, and Egypt, the last having fallen to the lowest place in 1903-4, in consequence of the change made in crediting to the countries of final destination, instead of to Egypt, the large shipments of produce, principally rice and wheat, originally consigned to Port Said to await orders for delivery.

THE NORWEGIAN PAPER INDUSTRY.

The modern paper industry of Norway may be considered to date from the same period as the chemical pulp industry, that is to say about the year 1880. Although writing paper has been manufactured in that country for one hundred years, the quality of the article produced is not of the best, and the finer grades of such paper are therefore still articles of import. Rags are largely used in the mills producing writing paper. It is in the manufacture of printing, news, and wrapping papers that the Norwegian mills excel. The wood employed in the mills excel. The wood employed in the mills is mostly spruce. Connected with the paper mills is generally found a sawmill, where the butts of the large trees are sawn to lumber, while the tops, branches, and small trees which have been cut to thin out the forests, go to the pulp and paper mills. According to the American Consul-General at Christiana, both mechanical and chemical pulp are used by the Norwegian paper mills. The pulp is reduced to an even, consistent mass, containing about 60 per cent. of water, and conducted into a receptacle where sizing is added; thence through the paper machine, where it is evenly distributed in a thin layer on a wide endless belt, which passes through a system of hollow horizontal rollers. These rollers are heated by steam; they are placed side by side, with very little space between, and turn on their own axis on a vibrating metal frame. The belt holding the layer of pulp is carried along by the rollers, and the thin mass dries very rapidly. The width of the paper is determined by dividing belts, placed on each side of the main belt or bed, holding the unfinished paper. The dividing belts may be set apart for any desired width of paper. When the paper is dry, it is finally passed between two cloth-covered rollers, where it is given finish and lustre; thence between another set of warmed rollers, which completes the operation. As the paper escapes, it is received on a revolving reel and cut in the desired lengths. Trial has been made with Canadian spruce, which was sent over, and used in a Norwegian paper mill for experimental purposes. The Norwegians claim that their own wood is superior for the reason that it holds less resin than the Canadian. The mills at Skien employ about one thousand hands; they have eight machines, and turn out about 35,000 tons of paper annually. Norway possesses a number of valuable water powers, well distributed through the timbered districts. Transportation facilities are good, and wages low. The paper machines used are partly of home manufacture and partly imported, a considerable number coming from Germany.

HOME INDUSTRIES.

Watches and Plate.—Are watches plate within the meaning of the Customs Act, 1842? If so, they must be assayed, stamped, and marked before they can legally be sold, or exposed for sale, within the United Kingdom. Since the passing of the Act of 1842 finished foreign watches have never been treated as coming within the designation of plate, nor was it ever suggested that watches were liable to the duty as plate, which was not repealed till 1890. But last year the Goldsmiths' Company raised the question as to whether finished watches are covered by the word "plate" in the Act of 1842, and, in order to have the question settled, bought four watches, two of them in gold and two of them in silver cases. All admittedly were of foreign manufacture. The case was tried before Mr. Justice Channell, who decided against the Goldsmiths' Company. There was an appeal, and last week the Court, consisting of the Master of the Rolls, Lord Justice Cozens-Hardy, and Lord Justice Farwell, reversed Mr. Justice Channell's ruling. Sir Robert Finlay (who appeared for the defendants) had argued that no one would use "plate" as including gold and silver watches in common parlance. The Court of Appeal did not dispute this, but said "the question is not of the meaning of the word 'plate' in ordinary language, but in Acts of Parliament, where it undoubtedly includes gold and silver watch cases," a point, by the way, not denied by Sir Robert Finlay. "Perhaps," he had argued, "a large collection of watch cases might come within a digest of plate, but finished watches would certainly not come within the expression 'plate.'" Sir Robert Finlay contended again that it was much in his favour that, since the passing of the Act of 1842, finished watches had never been treated as coming within the bequest of plate; and Mr. Justice Channell thought that considerable weight ought to be given to what had been the uniform practice since the passing of the Act by those who had to administer it. But the Court of Appeal do not seem to have attached much weight to this argument, which to the layman may seem strong. When there was a dispute as to the meaning of a word occurring in an Act of Parliament more than 60 years old, said Sir Robert Finlay, the *contemporanea expositio* threw light on the question, and was rightly taken into consideration. But the Court of Appeal felt that "the principle of *contemporanea expositio* cannot be applied to so modern a statute as the Customs Act of 1842. When there are ambiguous expressions in an Act passed one or two centuries ago, it may be legitimate to refer to the construction put upon the expressions throughout a long course of years by the unanimous assent of all parties interested, as evidencing what must presumably have been the intention of the Legislature at that remote period," but an undisputed interpretation only 63 years old is, in the opinion of the Court of Appeal, entitled to no such weight. And to the further argument that traders have embarked in business—as they unquestionably have done—on the strength of this usage the Court of Appeal answered that this usage "is not supported by any facts set out in the special case, and would be disposed of, if alleged, by Feather v. Queen." The Court held therefore that Mr. Justice Channell's judgment must be discharged. There will no doubt be an appeal to the House of Lords. A very large business has been built up in consequence of the practice that has prevailed, and it is most important to the watch-making industry to have that final interpretation of the law on the subject which can only be got from a decision of the House of Lords.

Publicans and Licenses.—What is known as the Leeds judgment—delivered on November 8th, by a Court composed of the Lord Chief Justice, Mr. Justice Ridley, and Mr. Justice Darling—has had a most disturbing effect upon licensing justices and publicans, and on Tuesday the Government introduced a short Bill, which is of course retrospective, to make clear the law. The facts are not in dispute. The Leeds magistrates resolved to extinguish the licenses of fifteen public houses as unnecessary, and this involved compensation under the Act of 1904. Against this decision, "the trade" appealed on the ground that the tribunal, which had refused to renew the licenses was unlawfully constituted. The Act of 1904 requires that in county boroughs, of which Leeds is one, the licensing authority shall be the whole body of justices, unless they delegate their powers to a committee. But this was not done at Leeds, though there was a body popularly called the licensing committee. Consequently the whole body of justices should have dealt with these licenses, whereas they were adjudicated upon by a small minority. The Court of King's Bench held that "the trade" was in the right in their view of the law, or if not that there must be "at least a majority" of the justices present, which was not the case at Leeds. Unfortunately the magistrates were not represented at the hearing in the King's Bench, the reason being that they would have had to pay the legal expenses out of their own pockets, which seems strange having regard to the general practice in similar matters. Be that as it may, the judgment has had far reaching effects. There is the further question, whether the legality of the arrangements for the administration of compensation funds is not involved. The Chief Constable of Bradford is taking legal advice with reference to the control of licensed houses, and fourteen Bradford brewers are about to apply for an injunction to prevent payments out of the compensation funds except under an order from the Court, and at the same time return of publicans contributions is to be demanded. The chairman of the Manchester licensing justices (Sir T. Thornhill Chance) in a letter to the Home Secretary, says that the real importance of the decision is its obvious effect on the legality of the compensation fund already established. "In January, 1905, the justices imposed charges for the establishment of

the fund, and the sum of £30,000 was paid into the fund by license holders on that account, and the whole of this sum has been paid away." Similar charges were imposed in January, 1906, and have been collected. There was not a majority of the justices present when the charges were imposed. There are about 200 qualified magistrates on the Manchester Board, and to secure the attendance of at least 101 justices would be practically impossible. The Government have recognised the seriousness of the position created by the decision of the High Court by the promptitude with which they have brought in a Bill to make the law clear.

Home Work by Employés.—The Home Secretary has addressed a letter to each of the City and Borough Councils of London, urging them to more vigilant enforcement of such provisions of the Factory and Workshop Act, 1901, as relate to home work by *employés*. Mr. Gladstone points out that outworkers are the weakest section of the labouring class, and the class in respect of which the State, from the nature of the circumstances, is least able to control the conditions of the work. If, therefore, it is to be effectively controlled, the local authorities must make a full use of their powers. Herein lies the difficulty. The Act of 1901 gives full powers to the local authorities, but these powers are often permissive only. Section 112 of the Act enacts that if any manufacture, process, or description of manual labour, which in pursuance of the Act, has been certified by the Secretary of State to be dangerous, is carried on in a domestic factory or workshop, all the provisions of the Act shall apply as if the place were a workshop other than a domestic factory or workshop. The local authority may take the necessary steps to put an end to the state of things complained of, but does not appear to be bound to do so. Thus, Section 110 enacts that "if any inmate of a house is suffering from an infectious disease to which this Section applies, the District Council of the district in which the house is situate may make an order forbidding any work to which this section applies to be given out to any person living or working in that house or such part thereof as may be specified in the order, and any order so made may be served on the occupier of any factory or workshop, or any other place from which work is given out, or on the contractor employed by any such occupier;" but though the section gives the power to the local authority it is not mandatory. There are obvious difficulties in the way of making it so, but the permissive character of the law as it applies to the outside worker makes such injunctions as that just issued by the Home Secretary very necessary in cases where the local authority is apathetic or indifferent.

Shipping Rings and the Government.—The Government have appointed a Royal Commission, of which Mr. Arthur Cohen, K.C., is chairman, to inquire into the operation of shipping "rings" or conferences generally, and more especially into the system of deferred rebates, and to report whether such operations have caused, or are likely to cause injury to British or Colonial trade, and if so, what remedial action should be taken by legislation or otherwise. This Commission has been asked for for some years past, and the evidence it collects will enable judgment to be formed upon a highly controversial matter. If shippers and importers are to be believed there are shipping "rings" in existence which are highly detrimental to British trade, favouring the foreigner at the expense of the British producer. The shipowners, and others concerned on the other side, are equally positive in their denials of unfair treatment.

Canals.—The Royal Commission on Canals and Waterways has taken the unusual but convenient course of publishing a mass of evidence before the conclusion of its investigation and the preparation of its report. It has examined 54 witnesses, and apparently completed its investigation so far as England is concerned, but has still to inquire into the systems of Scotland and Ireland. The evidence now available brings home the complexity of the subject and the difficulties of the problem to be solved. All the witnesses are in substantial agreement that the larger canal systems are performing very useful services in facilitating inland transport, but the witnesses are equally agreed that many of the waterways now derelict cannot profitably be restored. The evidence points to the conclusion that a canal is most profitably employed to connect an inland industrial centre with a seaport, and to establish direct water communication for the export and import traffic of the manufacturers. It follows that the canals which would probably give the best return for capital spent upon them are those which lie between seaports and centres of manufacture. But the difficulties in the way of improvement are many and serious, and the suggestions of the Commission as to how they are to be overcome will be awaited with interest. Not the least of the difficulties is the variety of ownership and control. The same canal is owned at different places by different companies, with different tolls and different gauges. Though there are nineteen through routes by water in England and Wales there is not one which has the advantages enjoyed by each of the railways with which they compete, of being under a single body. As the authors of "Our Waterways" have pointed out, on the three routes, connecting London and Liverpool, there are, including the authorities of navigable tideways, such as the Mersey, Severn, and Humber, twenty-six different bodies—and were until 1894, twenty-eight—which compete with each other; and there are twenty-seven on the four routes between London and Bristol, ten on the three between Birmingham and Bristol, and the same number on the three between Hull and Liverpool. And so with the gauges. On the shortest of the last-named three routes, a consignment of goods has to traverse ten

different waterways, the gauges on the locks of which range through various grades, from 50 feet by 14 feet by 4·6 feet on Sir John Ramsden's canal, to 212 feet by 22 feet by 9·6 on the Aire and Calder. The sectional area of the latter canal again is 475 square feet; that of the Trent and Mersey, 136 square feet; and that of the Weaver navigation, 780 square feet. Some of the witnesses examined by the Commission are of the opinion that, given greater facilities for amalgamation, private enterprise may bring about unity of control, but whether it would be possible to bring large systems under one management without the intervention of the State is questioned by the authorities. And any such intervention would be beset by obstacles. It was, however, strongly advocated by Mr. Lloyd and Mr. Abernethy before the Select Committee of 1883, while the proposals for its adoption made by the Associated Chambers of Commerce were only abandoned in favour of those for establishing a Canal Trust on account of the difficulty of persuading Parliament to provide the funds necessary for carrying it out. It is also to be borne in mind that the ownership of canals by the State has produced successful results in India, and throughout the continent of Europe.

GENERAL NOTES.

Cocoa and Grenada.—The absence of fluctuation in the yield of cocoa plantations has been so often adduced in favour of cocoa cultivation, and Grenada owes so much to the cocoa tree, that it may be noted that they suffered considerably from the shortage of the crop, which was some three thousand bags less than for the previous year, whilst prices fell heavily, thereby adding to the difficulties of the situation. In his report (Cd. 2684), the Governor, Sir N. B. Llewelyn, attributes the shortage of the crop in large part to unequal incidence of rainfall during the year, and these unsatisfactory prices were indirectly attributable to the largely increased influx of West African cocoa into the market, which seriously affected the sale of the lower grades of West Indian cocoa. Fortunately, there is every indication of continuance in the present increase of consumption, and it is a little surprising that those young Englishmen with capital at their command, and acquainted with country life, do not try cocoa cultivation in the West Indies. It offers pleasant possibilities to the young, energetic, and up-to-date agriculturist.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

December 12.—"Fruit Growing and the Protection of Birds." By Cecil H. Hooper, Member of the Council of the National Fruit-Growers' Federation.

December 19.—"Modern Developments of Flour-Milling." By Albert E. Humphries, President of the Incorporated Association of British and Irish Millers. Professor Thomas Hudson Middleton, M.A., will preside.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

December 13.—"The Indian Mohammedans: their Past, Present, and Future." By A. Yusuf Ali, M.A., LL.M. (Cantab.), I.C.S. Lord Ampthill, G.C.S.I, G.C.I.E., will preside.

January 24, February 14, March 14, May 2, 30.

Applied Art Section.

Tuesday evenings, at 8 o'clock:—

December 18.—"Basket-Making." By Thomas Okey. Lewis Foreman Day, F.S.A., will preside.

January 29, February 19, March 19, April 30, May 28.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

January 15, March 5, April 23.

Papers to be read after Christmas:—

"The Straits of Panama." By Philippe Bunau-Varilla, formerly Chief Engineer of the Panama Canal Company.

"The Principles and Practice of Insurance, and their modern Developments." By Thomas Emley Young, B.A., Past President of the Institute o Actuaries, and Past Chairman of the Life Offices Association.

"Smoke Prevention in Factories." By John B. C. Kershaw, F.I.C.

"The Underground Water Supply of the Thames Basin." By Clayton Beadle.

"Engraving and Photogravure." By. J. Craig Annan.

"Mediæval Stained Glass, its Production and Decay." By Noel Heaton, B.Sc.

"Cold Storage and Food Supply." By Hal Williams.

"Modern Typewriters and Accessories." By Arthur E. Morton, Examiner in Typewriting to the Society of Arts.

"Motor Omnibuses." By Lord Montagu of Beaulieu.

"Apprenticeship." By James Parsons, M.A.

"Artistic Treatment of the Exterior of the Pianoforte." By William Dale, F.S.A.

"Joinery and Cabinet Making." By A. Romney Green.

"Oils, Varnishes and Mediums." By ARTHUR P. LAURIE, M.A., D.Sc., F.R.S.E.

"Sheffield and Electro-plate." By SHERARD COWPER-COLES.

"The Progress of the Uganda Protectorate." By G. WILSON, C.B.

"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G.

"The City of Madras." By SIR JAMES THOMSON, K.C.S.I.

"The Applicability to Indian Rivers of the Italian System of dealing with Silt." By SIR EDWARD C. BUCK, K.C.S.I.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

A. D. HALL, M.A., Director of Lawes Agricultural Trust, "Artificial Fertilisers: their Nature and Functions." Five Lectures.

LECTURE IV.—DECEMBER 10.—*Phosphatic Fertilisers.*

LECTURE V.—DECEMBER 17.—*Potassic Fertilisers. Consumption of Fertilisers.*

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

January 28; February 4, 11.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

JUVENILE LECTURES.

Wednesday afternoons, January 2 and 9, 1907, at 5 o'clock.

"Perils and Adventures Underground." By BENNETT H. BROUGH.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. D. Hall, "Artificial Fertilisers: their Nature and Functions." (Lecture IV.)

Farmers' Club, Whitehall-court, S.W., 6 p.m. Mr. H. Trustram Eve, "Freedom in Farming, with special reference to Selling off Produce."

University of London, South Kensington, S.W., 8 p.m. Mr. Banister Fletcher, "Greek Temples of the Corinthian Order."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. L. S. Wood, "The Improvement of our Woodlands."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Major J. H. Bealom, "Irrigation in the United States."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Review of Professor Flanders Petrie's work on "Sinai," by the Secretary.

London Institution, Finsbury-circus, E.C., 5 p.m. Rev. J. Stephen Barras, "The Churches of the City."

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. (Graduates Section.) Mr. A. B. Symons, "Up-to-date Milling Machines."

TUESDAY, DEC. 11...Asiatic, 22, Albemarle-street, W., 4 p.m. Mr. G. Pinches, "The Tablet with Cuneiform Text from Yuzghat."

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Dr. A. C. C. Cumming, "The Electrochemistry of Lead." 2. Dr. A. C. C. Cumming, "Contributions to the Study of Strong Electrolytes." 3. Mr. R. W. Vicarey, "Storage Batteries aud their Electrolytes" (Part II.).

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on following papers:—"The Talla Water-Supply of the Edinburgh and District Water-Works;" "Repairing a Limestone-Aqueduct;" and "The Yield of Catchment-areas." 2. Mr. H. W. E. Le Fanu, "Mechanical Considerations in the Design of High-Tension Switch-Gear."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Optical Society, at the British Horological Institute, Northampton-square, E.C., 8 p.m. Dr. C. V. Drysdale, "The Evolution of Artificial Lighting."

Photographic, 66, Russell-square, W.C., 8 p.m. Dr. W. J. S. Lockyer, "Thunder Storms and a Camera."

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. A. W. a'Beckett, "The Colonial Press."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, DEC. 12...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Cecil H. Hooper, "Fruit Growing and the Protection of Birds."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, DEC. 13...SOCIETY OF ARTS, John-street, Adelphi, 4½ p.m. (Indian Section.) Mr. A. Yusuf Ali, "The Indian Mohammedans: their Past, Present, and Future."

Royal, Burlington-house, W., 4 p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Mr. Matthew Webb, "Gesso-work."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. J. W. Jenkinson, "Tadpoles—a Study in Embyology."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, DEC. 14...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. A. Carmichael, "Mechanical Improvements in the Drainage of the Bedford Level."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Lace."

Astronomical, Burlington-house, 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Conclusion of discussion on Mr. Thomas Clarkson's paper, "Steam as a Motive Power for Public Service Vehicles." 2. Mr. Henry Fowler, "Lighting of Railway Premises: Indoor and Outdoor."

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FRIDAY, DECEMBER 14, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, DECEMBER 17, 8 p.m. (Cantor Lectures.) A. D. HALL, M.A., "Artificial Fertilisers: their Nature and Functions." (Lecture V.)

TUESDAY, DECEMBER 18, 8 p.m. (Applied Art Section.) THOMAS OKEY, "Basket-making."

WEDNESDAY, DECEMBER 19, 8 p.m. (Ordinary Meeting.) ALBERT E. HUMPHRIES, "Modern Developments of Flour-Milling."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 2nd and 9th, at 5 o'clock, by BENNETT H. BROUGH, F.G.S., F.I.C., F.C.S., on "Perils and Adventures Underground."

Each Member is entitled to a ticket admitting two children and an adult. A sufficient number of tickets to fill the room will be issued to Members in the order in which applications are received. Members who desire tickets for the course are requested to apply for them at once.

CANTOR LECTURES.

On Monday evening, 10th inst., Mr. A. D. HALL, Director of the Lawes Agricultural Trust, delivered the fourth lecture of his course on "Artificial Fertilisers: their Nature and Functions."

The lectures will be published in the *Journal* during the Christmas recess.

INDIAN SECTION.

Thursday afternoon, December 13th, the Right Hon. Lord AMPTHILL, G.C.S.I., G.C.I.E., in the chair, the paper read was—"The Indian Mohammedans: their Past, Present, and Future." By A. YUSUF ALI, M.A., LL.M. (Cantab.), I.C.S.

The paper and discussion will be published in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

FOURTH ORDINARY MEETING.

Wednesday, December 12th, 1906: SPENCER PERCIVAL UMFREVILLE PICKERING, M.A., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Bainsmith, Mrs. Georgina, Fairholme, St. Ives, Cornwall.
Cuthbertson, Ebenezer, 33, Arncliffe-gardens, West Hartlepool.
Fletcher, Mrs. Esther, Ashville, Stourbridge.
Flurscheim, A., Chancery-lane Station-chambers, 31, High Holborn, W.C.
Habell, Frank Stannah, care of Messrs. W. Hill and Co., Elderslie Rock Blasting, Renfew, near Glasgow.
Higgins, Eric, 5, Oak-terrace, Fairfield, Liverpool.
Honey, Richard, International and Mortgage Bank of Mexico, Mexico City, Mexico.
Honey, Thomas P., International and Mortgage Bank of Mexico, Mexico City, Mexico.
Ibbs, Miss Edith A., 3, Endsleigh-gardens, N.W.
Keen, Walter Henry, Portland-lodge, Atkins-road, Clapham-park, S.W.
Raegener, Louis C., 141, Broadway, New York City, New York, U.S.A.
Roberts, James, 1, Paper-buildings, Temple, E.C.
Shafi, S. M., 54, Poonamallee High-road, Parktown Post, Madras, India.
Street, Arthur William, 37, Hamilton-square, Birkenhead, Cheshire.

Thompson, Charles, 11, Norfolk-street, Strand, W.C.
Wilson, George, C.B., Hans-crescent Hotel, Hans-crescent, S.W.

The following candidates were ballotted for and duly elected members of the Society:—

Blake-Thomas, Hugh, Cawsand, Pwllheli, North Wales.
Bradley, Benjamin Lawrenson, Barn-ith Wood House, Grindleford, Derbyshire.
Middleton, Robert Hugh, 26, Selborne-road, Ilford, Essex.
Muntri, Kashinath Gorindjee, 192, Worlee, Bombay, India.
Shaw, Mrs. W. T., Hypatia-lodge, Percy-villas, Campden-hill, W.
Smith, Harry E., Wrexham-house, Winn-road, Lee, S.E.
Stewart, James Ernest, care of The Pekin Syndicate, Limited, Tientsin, China.
Wilberforce, Professor Lionel Robert, 5, Ashfield-road, Aigburth, Liverpool.
Wild, Albert Edward, 30, Westbourne-terrace, W.

The CHAIRMAN, in introducing the author of the paper, said that when he was asked to take the chair, he felt, in the first instance, considerable diffidence in the matter, because Mr. Hooper was well-known as being allied with the interests of fruit growers. The generally reputed views of fruit growers on the subject of wild birds were very simple, viz., "Kill them all." If that had been Mr. Hooper's views, he (the Chairman) would have felt considerable diffidence in lending any support to them; but a very slight conversation which he had with the reader of the paper showed him at once that Mr. Hooper did not intend to take a one-sided view of the subject, but was going to deal with it fairly and squarely. There was no question that fruit growers had a very serious matter to deal with at the present moment in the shape of wild birds; and as a fruit grower himself in a small way, and as one who had devoted all his energies for some years past to the interests of fruit growers, he was fully aware that the question became more serious every year. For some years past he had been prevented at his own place in Hertfordshire from growing any currants or gooseberries, and at the present time he was engaged in the pleasant occupation of grubbing up 1½ acres of plum trees, which he had carefully tended for the last 15 years, simply because the birds took nearly every bud; and the gross returns on that 1½ acres for the last ten years had not averaged more than £3 per annum. At the same time, although fruit growers had his sympathy, it must be recognised that sympathy was due to the birds also. The fact must not be over-looked that birds did a great deal of good as well as harm; and the fact must also be taken into consideration, that they did good in a way, the money value of which it was difficult to estimate, viz, from a scientific, educational, æsthetic and humanising point of view. But those considerations would have to go to the wall if it became a question between them and the continuation of fruit growing in England, because an enormous amount of capital was invested in fruit-growing, and the livelihood of many men was dependent upon it, while it was one of the few remaining branches of agriculture which was paying and progressive in this country. The gist of the whole question was to find a *modus vivendi*—a "live and let live"—between the fruit growers and the birds; and the first step towards such an achievement was to make themselves more acquainted with the habits of wild birds, to find out which birds were noxious and which beneficial. In that research they looked to gentlemen like Mr. Hooper, who had given a large amount of time and study to the question.

The paper read was—

FRUIT GROWING AND BIRD PROTECTION.

By CECIL H. HOOPER, M.R.A.C.
Member of the Council of the National Fruit Growers' Federation.

When the Council did me the honour of inviting me to read a paper before the Society on this subject I felt tempted to undertake it, but knew the task could have been placed in very much better hands. I have had nearly fourteen years' experience of fruit farming, during which time I endeavoured to notice the action of birds in relation to fruit and other crops; but duly to study the habits and food of our wild birds necessitates much patient and watchful observation of the birds in their haunts during many years, as well as learning to recognise them from museum specimens and books. The habits of birds are taught in making a collection of eggs, by the use of the catapult, by the gun, and the examination of the crops of birds; but the harmless field glass is a great assistance, and photographing birds in their haunts must be most instructive. Passing on to the economic effect of birds with regard to the cultivation of fruit, it is all important that we should be fair and unprejudiced in our study of this vexed question, and it is only after studying the birds by their works that consideration should be given to beauty of song or plumage. The pleasure derived from observing birds, and becoming familiar with their plumage, their notes, and, above all, their habits, is never ending; and the habits and food of the every-day birds might with advan-

tage be taught to the children in more of our village schools.

There are certain birds which are distinctly beneficial to the farmer, fruit grower, and gardener if not allowed to become too numerous; but as soon as their numbers exceed a certain limit they become equally injurious, and cannot be regarded as other than enemies. In this category may be mentioned the blackbird, missel thrush, song thrush, starling, and rook. We need to observe the food of birds for the whole twelve months and for successive years in order to arrive at sound conclusions. Agriculturists and fruit growers admit that birds, as a class, are more beneficial than they are injurious to the cultivator. Yet many of the most common and injurious insects to fruit are eaten sparingly and by few species of birds, whilst there are others that I believe I am correct in saying are eaten by no bird, yet if left unattended kill the plant.

With the introduction of spraying, grease-banding, and other devices to prevent or destroy insects, fruit growers are less dependent on birds for their protection from injurious insects than they were, say, fifty years ago; yet the damage done by birds, in the opinion of old fruit growers, is more severe than at that date. The increase and spread of fruit cultivation probably favours the increase of birds that devour fruit and fruit buds; whilst the close preservation of game destroys the birds which act as a natural check on their undue increase and favours other birds living in the woods, such as the bullfinch and wood pigeon, which are injurious to the fruit grower and farmer, yet are not interfered with by the gamekeeper. Again, the many advantages possessed by the house sparrow in the struggle for existence has enabled it to multiply inordinately, to the detriment of other and more useful birds.

Mr. Radcliffe Cooke considers the enforced attendance of children at school till the age of fourteen, at which time they go to work, by stopping bird-nesting, has had its effect in the increase of small birds. Now that most of the less common birds' eggs are protected by law, children are often afraid to take any, and at many schools the teachers discourage bird-nesting. Far be it from me to depreciate in any way teaching kindness and humanity with regard to beast or bird, yet it probably affects materially the increase of the commoner birds, such as the house sparrow, the blackbird, the thrush, the chaffinch, and the greenfinch, of which in many cases we have too many for the good of those who have to live from the produce of Mother Earth.

Bird-minders must have a gun license, costing 10s.; and so must the farmer if he intends to scare birds, as no one is allowed to carry fire-arms without a license; twenty—or even ten years ago it was hardly thought necessary on a farm to take out a license for a short period of bird-scaring; the effect is that fewer persons use guns than formerly.

Preservation of Hawks and Owls.

Landowners, sporting tenants, and especially gamekeepers should be more merciful to hawks and owls unless actual injury to their birds occurs. A friend in Herefordshire wrote me that the other day he spoke to a gentleman who preserves largely, saying that the sparrow-hawk was the only bird of the kind that was at all destructive to game. He replied: "I don't know one kind from another; all I know is that when I get a chance to shoot a hawk I do so." Again, as to the destruction of owls, some time ago a bird-stuffer in Gloucestorshire told a lady he had sixty skins of owls to stuff. He regretted their destruction, but it was not to his interest to ruin his connection with customers by informing against them. This summer I saw a dead long-eared owl which had been shot in Norfolk by an ex-policeman, apparently merely for the pleasure of shooting at something. It was not even going to be stuffed.

Causes Influencing the Increase or Decrease of Certain Birds.

Among the most evident natural influences that govern the increase or decrease of certain birds are:—

1. Migration, not only from one country to another, but from different parts of our own country.
2. The character and habits of the bird.
3. The quantity of food available.
4. The number of young the birds rear yearly.
5. The capability of the bird to withstand adverse conditions, such as long continued snow and frost.

As an example of birds moving from place to place, blackbirds and thrushes do not appear to diminish noticeably in numbers, though shot or trapped, thus a fruit-grower in Herefordshire, with 100 acres of plantation, drives the blackbirds in the summer in the early morning, with his three sons and a keeper who have shot as many as 70 or 80 in a morning including a few

thrushes, totalling some 2,000 in a year, yet the blackbirds still come every year without much diminution; he has given up growing red currants on account of the birds.

The Boughton Sparrow Club last year reported nearly 6,000 sparrows, but even that number, it was stated, makes no perceptible difference in the number this year.

The thrush family are considerably distressed by long-continued snow and frost, in fact a severe winter; but the blackbird resists the effect of winter better than the thrush because it lives on berries which have fallen off trees, and hunts under the leaves for food. Starlings can take care of themselves in severe weather better than the thrush family. The house sparrow is still more favoured by its audacity, its hardihood, its wide variety of food, and its large progeny.

CHANGE OF HABIT OF BIRDS.

That birds may change their habits we have undoubted example in the kea or mountain parrot of New Zealand, which used to eat nuts, but since the introduction of sheep, has changed to eating fat—first from the butcher's shop, next from dead sheep, and now it pecks through the backs of live sheep.

In conversation with fruit-growers I have been told, after explaining the damage done, this bird used not to do such and such damage; thus the sparrow pinching the flowers of the gooseberry appears to be a habit that is increasing, also its tendency to eat fruit. Mr. O. V. Aplin, in his useful letter to the Central Chamber of Agriculture in reference to birds injurious to agriculture and to fruit-growing, wrote:—

"Some birds have altered their habits in respect of food. The alteration may be owing to the increase in numbers of the particular species which has altered its mode of feeding, or it may be owing to the great increase of some other species. For instance, I am inclined to think that the enormous increase of the starling has caused the rook to alter its food; the starling eats up the animal or vegetable food the rook formerly lived on in the spring, and the rook eats more corn and fruit and has taken to eating partridge and other birds' eggs to make up for it. Ten years ago in this district of Oxfordshire the damage done by birds to the fruit-grower was practically nil. The blackbird now, besides eating bush fruit in increased quantities, eats plums, apricots, pears and apples. Unlike the thrush, which continues its snail and worm diet all the summer (and, I think, eats no more fruit than it used to do), the blackbird from the time the first bush fruits ripen until autumn lives upon fruit. The damage done to plums is a new thing here, and is now most serious.

"The starling used only to eat a few cherries, now it also eats strawberries, currants, plums (even on wall trees), early pears in great quantities, and apples. Almost all this damage is quite a new thing, and it gets worse each year. The blue tit pecks holes in pears and apples to a serious extent. Here it has only taken to this recently; the habit grows year by year."

A writer from Cornwall in the *Field* of November 3rd, 1906, said:

"I have never known it before, but this year the blackbirds have been perfectly ravenous for tomatoes. I have some growing against a wall out of doors, and the birds even pecked through fish net to get the fruit; curiously enough no other birds were seen to touch them. I watched a thrush foraging near a partly eaten tomato and it did not touch it."

Mr. Till, of Eynsford, wrote me that a few years ago his mulberries were comparatively safe, now starlings and thrushes clear the lot —hundredweights are borne by the tree and the birds have all; so with the cherries on big trees that cannot be netted. The field fruit is protected by scaring, so the birds come where they are not and cannot be scared. He contends the game laws are at the bottom of the mischief, and that we are sacrificed that a few may have sport.

THE LEGAL PROTECTION OF BIRDS.

Protection of birds by law is no new thing. If mankind had followed the humane command given through Moses, in Deuteronomy xxii. 6 (viz., not to take both young and parent bird, and if the young are taken to spare the mother bird), many of the birds the loss of which naturalists deplore would still be in existence. In the City of London, in 1555, kites and ravens were protected by law for their value in feeding on garbage of the streets and even of the Thames.

The Report of the Select Committee on Wild Birds' Protection, in 1873, tells us that "while birds of prey are being banished, owing to poultry-keepers and game-preservers, the reclamation of wastes, the enclosure of open spaces, and the greater care bestowed on timber trees by removing those that, being decayed, are much infested by insects, the smaller denizens of the woodlands, gardens, and arable fields are unquestionably more numerous than ever."

THE WILD BIRDS PROTECTION ACTS, 1880 TO 1904

have for their object apparently the protection of the rarer and non-injurious birds

and their eggs throughout the year, and of all the birds during the breeding season. The birds and eggs to be protected are decided on by each County Council, and these appear all to vary, influenced by differences in the mode of agriculture and other considerations.

The general public, other than an owner or occupier of land or person authorised by either, may not take or destroy or incite anyone else to take or destroy any wild bird soever between March 1st and August 1st on pain of a reprimand and payment of costs for the first offence, or 5s. for subsequent offences in the case of non-scheduled birds, and up to £1 fine for scheduled birds, with forfeiture of the bird in both cases. The landowner, the occupier, or persons authorised by either, may shoot or trap any bird not protected in the schedule at any time in the year.

In 1904 the use of the cruel pole-trap, which used to be specially used by gamekeepers to catch owls, hawks, jays, and other birds, was prohibited under a penalty of £2 for first offence, and £5 for subsequent offences.

Nets, snares, and decoy birds may be forfeited in the case of illegal taking of birds. Any person may demand the name and address of a person offending in shooting or trying to shoot any scheduled birds or taking scheduled birds' eggs.

Taking the list of protected birds in Kent. The close time in Kent is March 1st to August 13th. All birds are protected from being shot or snared on Sundays in nearly all the parishes of Kent. The commoner birds that a landowner, tenant, or persons authorised by either may shoot or trap without offence include :—House and tree sparrows, bullfinch, greenfinch, brown linnet, hawfinch, blackbird, missel and song thrushes, lark, hedge-sparrow, tree-creeper, the tits (except the long-tailed), wood-pigeon, stock-dove, dove, starling, rook, jay, jackdaw, sparrow hawk, &c.

The eggs of all the above-mentioned birds may be taken by anyone without offence, save those of the hawfinch, linnet, and lark, and in the metropolitan area the starling.

Of the commoner birds and their eggs that are protected in Kent may be mentioned the goldfinch, flycatchers, kestrel hawk, all the owls, swallow, house and sand martins and swift.

Of birds protected and the eggs of which are protected only in the metropolitan district :—wren, redstart, white throat, garden warbler, blackcap, nuthatch, cuckoo, wagtails.

Of birds protected, eggs not protected :—chaffinch, robin, lapwing, turtle dove. In the metropolitan district the magpie and its eggs are protected. In Kent there are certain areas in which all birds' eggs are protected.

In Worcestershire the protection of all birds on Sunday is not in force ; and somewhat fewer birds are protected.

I do not wish to criticise this attempt at protecting wild birds, but I would mention that to obtain the above brief information I had to study six brief Acts of Parliament. Why are they not summarised ? It took me several hours to summarise them, and then I had to consult the village policeman to know whether I understood them aright. He said he stopped all boys taking the eggs of any bird; gamekeepers kill everything they fancy, including owls and hawks, without interference ; he knew of several pole-traps at present in use in the district; he thought that farmers could shoot any bird they found doing harm to their crops, and that all persons might catch sparrows for Sparrow Clubs, though not directly authorised by a farmer. The latter is what one would expect, but the law states that no person other than a landowner or occupier of land, unless authorised by either, may kill any bird. School children, I think, fancy they are prohibited taking any birds' eggs, whereas they are free to take those of sparrows, blackbirds, thrushes, greenfinches, bullfinches, wood pigeons, and, if they can get at them, rooks, and other eggs not scheduled, but for fear of the policeman they consider they are doing wrong to take any. The chief duty of the police, as regards birds, appears to be to stop bird catching (more particularly the goldfinch) on Sunday, yet bird catching is legal on Sunday in the next parish. With regard to the birds protected, I have but little fault to find, and would only suggest that I think the chaffinch and hawfinch need no protection throughout the country, nor the eggs of the starling in the Metropolitan district.

Is it justifiable to decrease the number of injurious birds ? Unmistakably many of the smaller birds are increasing inordinately, to the detriment of cultivated crops, gardens, &c.

Weeds, injurious insects, and fruit-eating birds all entail increased labour to arrive at a successful crop, is it less justifiable to regulate the number of birds than the weeds and insects ? There is no doubt that man, whom Providence has placed as lord over the brute creation, was intended to control and regulate

the limits of animal and vegetable life. What would happen if rats, mice, rabbits, cats and wasps were allowed to multiply without check?

It is really our duty to regulate the birds in reference to the benefit of agriculture, horticulture and forestry, by specially preserving the most useful, and by lessening the number, in the most merciful way practicable, of those which are injurious.

What is the effect of lessening the number of small birds, and does it influence the number of insects? On the Continent they eat thrushes, blackbirds, house sparrows, and even robins.

In France and Belgium there are few small birds because they are shot and eaten, but in a tour of northern France and Belgium Mr. Frederick Smith says he did not see any crop damaged by insect pests, except the small ermine-moth caterpillars on apple trees, and birds will not eat these in any case. Here buzzards, harriers, the smaller hawks and owls and magpies are plentiful. But the crops were certainly not suffering from insect pests, and he thinks we very much overrate the good the birds do and do not take into consideration the harm they do in destroying the predatory insects, such as the lady-birds and their larvæ, the lacewing fly and ichneumon fly, all of which destroy our insect foes. Again, in the case of weed-seed eaten by birds, not all is cracked and digested, many seeds must be carried about and the weeds spread.

I propose now to speak of the food and habits of the commoner birds which have an influence for good or ill on our fruit plantations, commencing with those which are injurious.

Birds Partially Injurious to Fruit Cultivation.

The Common or House Sparrow, though not individually as destructive to buds as the bullfinch, yet by its immense numbers is a most serious pest to the fruit-grower, as it is to the corn-farmer, to the owner of poultry, by taking corn given to fowls, and to the gardener, by destroying his seedlings. This year, even in the beginning of November, it had started eating the buds of red currants, the injury being noticed by a grower, who was cottoning his bushes in order to try and protect them. The sparrow is very severe on gooseberry buds, particularly in February, and this injury is quite apart from insect attack, as Professor F. V. Theobald tells us no insect attacks gooseberry or cherry buds. It also eats plum buds, particularly those of the damson.

Mr. W. Huxley wrote me from Gloucestershire:—

"The sparrow is a great offender to most fruit growers, especially in winter and very early spring. I have known sparrows to destroy two acres of gooseberry bushes (in one year) by taking out 90 per cent. of the buds. The result was that the few buds that were left went to wood, and in a few years the bushes had scarcely a bud upon any of the lower branches. I have known sparrows do this to the following kinds of gooseberries: — 'Keepsake,' 'Crown Bobs,' 'Lancaster Lads,' 'Monarchs,' and 'Whinham's Industry.' On the other hand, I have seen sparrows destroy thousands of caterpillars of the winter moths. But as the destruction of winter moths does not depend upon the sparrow, I think it would be wise to destroy a good percentage of sparrows."

In May, or as soon as the gooseberry flowers open, the sparrows come to the blossoms and squeeze them, apparently for the sweetness of the nectar in the bloom, as they do not eat the flowers, but let them drop, and they continue to interfere with the blooms till the young gooseberries are formed; but this snibbing of the bloom causes the young fruit to cease growth, and invariably drop off. This gooseberry flower destruction is also practised by the chaffinch. Aspect of land does not appear to affect the matter, but the injury is worst near buildings and high trees. Mr. J. Blundell, a fruit-grower of long experience at Halstead, Kent, considers that the picking of flowers and young fruit of gooseberries is a habit acquired within the last few years, and that "Whitesmith," a two-thorned variety, suffers considerably, whilst "Warrington," which has three thorns, is not so much affected.

The sparrow pecks the blooms of plums, cherries, and sometimes of apples, and takes a few ripe strawberries, cherries, gooseberries, unripe red currants, also filbert and cob nuts.

Mr. J. H. Gurney and Colonel C. Russell in their excellent little book on "The House Sparrow," based on the careful examination of nearly 1,000 house sparrows at different times of the year, through 15 years, summarize the food of an adult sparrow as follows:—Corn, 75 per cent.; weeds of seeds, 10 per cent.; green peas, 4 per cent.; beetles, 3 per cent.; caterpillars, 2 per cent.; insects which fly, 1 per cent.; other things, 5 per cent. In young sparrows not more than 40 per cent. is corn, while about 40 per cent. consists of caterpillars, and 10 per cent. of small beetles. To see what a sparrow has been eating it should be killed in the afternoon; if caught in the evening, its food has in great measure been digested. Mr.

Gurney writes, "I am sure that while very young their diet is as much unripe corn and vegetable matter as caterpillars; even at the age of one day a sparrow will feed its young one on a grain of ripe corn." In this little book the customary and occasional food of both the adult and young sparrow is given for each month in the year.

Sparrows take the nests built by martins and swallows, and the general opinion is that the latter useful insectivorous birds, through being thus ousted, are less numerous than, say, 20 years ago. I was told of a case in which there were 16 martins' nests on a house, and when the owner returned he found them all occupied by sparrows. It has been stated that it is owing to the decrease of swallows that the hop aphis and wheat-midge are increasing so much.

The audacious sparrow, even in the few insects it does eat, takes this food from more useful birds. The sparrow multiplies fast, as it lays five or six eggs and has three or four broods in a year. One pair frequently produces more than 20 young in a season, and, were no disasters to betide them, the progeny of one single pair in six years would amount to millions. The Rev. H. H. Slater, in the excellent paper on "Wild Birds of the Farm," read before the Farmers' Club in 1905, says, that if the parent birds of a nest are killed, other sparrows will feed their young. The house sparrow is unmolested in towns, parks, and villages, and consequently, increases out of proportion to other birds.

Mr. F. Smith, in his very observant and practical paper on "The Fruit Grower and the Birds," read this year before the Maidstone Farmers' Club, adds to the already long list of sins of the sparrow, that he has seen it eating ladybird larvæ and beetles on hops, which insects are so useful in eating aphides. Among the injurious insects that the sparrow has been observed to eat are the looper caterpillars of the winter moth, aphides on damson trees and brussels sprouts, and beans, the leaf-roller caterpillar on roses, cabbage butterflies and their green caterpillars, caterpillars on gooseberry bushes, wireworms, crane flies, weevils on peas and beans. But, in general, although the insects may be very numerous, they constitute only a very small proportion of the sparrow's food, nothing appreciable to the damage done by the sparrow.

In America it is considered "a destructive bird, worthless as an insect killer."

The late Miss E. Ormerod, one of the kindest and wisest of naturalists in the leaflet "The House Sparrow," issued by her and the great bird authority Mr. W. B. Tegetmier, concludes by recommending the formation of Sparrow Clubs.

The Board of Agriculture has issued a useful leaflet with suggestions on the formation of sparrow clubs; some clubs, in fruit districts, include the destruction of the bullfinch, whilst in hop districts the greenfinch is included. Our forefathers knew that the sparrow needed to be kept in check when, at the beginning of last century, the churchwardens paid for sparrows' heads and eggs. We have made a mistake in destroying the sparrowhawk, and not taking practical interest in forming village sparrow clubs.

I have not mentioned poisoned wheat, but if sparrows increase, as at present, legislation may consider it wise to authorise the destruction of the sparrow by this means; perhaps appointing certain men thus to lessen the number, and collect and destroy the poisoned birds. Sparrows are poisoned in New Zealand and Australia (*vide* Mr. Charles Whitehead's article on "the Sparrow" in "Ornithology in Relation to Agriculture and Horticulture").

Mr. F. Smith says:—

"For reducing the number of sparrows the best thing he has known was Harding's prepared wheat. It would not kill anything larger than a sparrow or mouse—it would not kill rats or poultry. But the Government of the day brought in a Bill making it illegal to poison wheat in any way. Still, something might be done by appointing a certain number of men to kill sparrows by this means by permission of the Board of Agriculture."

The Bullfinch—which has been briefly described as not having one redeeming feature save his appearance, seems to be somewhat local, and is probably most plentiful near woods. Where numerous in a fruit-growing district, it seems that for self-protection they must be killed, as the damage they do to the buds is a very serious matter, and often they wantonly destroy the buds without even eating them. They commence soon after Christmas, when the first spell of frost has sweetened and swollen the buds, and continue eating them until the buds expand into leaves. The worst time is the beginning of March.

The bullfinch feeds on buds, especially of plants that bear fruit, such as plums, damsons, cherries, gooseberries, currants, apples, and pears; it shows a special liking for Greengage, Black diamond, Purple gage, and Early Rivers plums, which it will first attack in an orchard. It shows a preference for

certain varieties of gooseberries, and amongst apples, the buds of "Councellor" are favourites. It also attacks the buds of hawthorn, blackthorn, bird-cherry, larch, and beech. Mr. F. Smith, of Loddington, says that bullfinches rove about, in families of five or six, through the winter. A family will come into a fruit tree, and stay there till they have destroyed all the buds, both fruit and wood; they usually begin with "May duke" cherries, in the early autumn, and keep on with plums, gooseberries, currants, and medlars; ending, in late spring, with black currants and apples. For six months they live almost entirely on fruit buds; on dissection, their crop may be found full of buds, while insects occur in very small numbers. The crops of bullfinches have been found full of gooseberry buds. even during the time gooseberries were coming into blossom; for the other six months they feed on various weed seeds, as nettle, dock, chickweed, thistle, ragwort, plaintain, sowthistle, and the flowers of groundsel; but it is an open question to what extent this is of real value, as many seeds of weeds pass through birds undigested, and these seeds are distributed by the birds.

Mr. C. F. Archibald considers it is even doubtful whether insects form the main support of the young of the bullfinch, for they appear to be fed on seeds softened by their parents. When raspberries are ripe, bullfinches eat these; also blackberries, hips-and-haws, privet and rowan berries. As it commonly builds its nest in thick woods, protected by game preservers, it multiplies in safety; this accounts for its comparative abundance, and even increase, in the face of persecution.

Mr. George Abbey, in his articles on "British Birds" in the "Journal of Horticulture" for 1904, recommends lime wash spraying for the bushes, for preserving the buds, as most effective; and I can also recommend it.

The Blackbird, as far as the fruit-grower is concerned, is the blackest of thieves; this handsome but sly bird appropriates strawberries, currants, cherries, gooseberries, raspberries, apples, plums, and other fruit; they frequently commence the attack whilst the fruit is green, and if unmolested, they will in many cases, devour the entire crop. It is, unfortunately, almost impossible to keep them from the fruit with any degree of efficiency without destroying them; for they exhibit considerable cunning in finding their way under netting, and soon learn to disregard any method of scaring, which they find by experience may be braved with impunity.

Prof. F. V. Theobald wrote me recently:—"Blackbirds have been terribly destructive to fruit in Worcestershire, Herefordshire, and Kent this dry year; there are far too many."

This summarizes what I have heard from many growers. My brother wrote me from Pershore, Worcestershire:—

"Here the blackbirds have been an awful nuisance with red currants, raspberries, and gooseberries. This has been the worst year for birds I can remember; probably because there was so little fruit about, and the summer so dry. Next spring I intend to destroy all the young blackbirds in their numerous nests in my hedge-rows."

A fruit-grower in Bedfordshire wrote that in order to keep blackbirds and thrushes within reasonable bounds he has this year used 27 traps and caught 500 of these birds; first placing them on the strawberry beds, then under gooseberry bushes (where he caught most), and then under the apple trees.

Blackbirds appear to have increased largely lately, only a partial migration to the south takes place in the autumn with this bird; some authorities say that individuals reared in Britain do not migrate; but annually great flocks arrive on the eastern shores of England from more northern countries, remaining for a few days only and then proceeding southward. Blackbirds multiply fast, having two, three, or four broods in a season, the young of the first brood sometimes assisting their parents in feeding the young of the second. The food of the blackbird, other than cultivated fruit, consists largely of worms, beetles, caterpillars, and larvæ of insects; snails are eaten in winter, and probably slugs, also blackberries and the berries of hawthorn, yew, and dogwood. In nursery rhyme days they appear to have been a royal dish. Why not kill and export blackbirds to France?

The Starling, though an excellent bird on grass land and valuable in woods, is very severe and persistent on fruit, especially cherries and damsons, and, as the men say, "will not take no for an answer," and often will not leave the tree unless actually shot. Together with blackbirds and thrushes it attacks strawberries. Mr. George Abbey informs me that at Eltham it destroyed also pears, apples, and plums. They swoop down in flocks on the raspberry fields at Swanley, in Kent, especially in hot weather.

Starlings are said on all sides to have greatly increased; they also come from

abroad. Their numbers should be kept within bounds, as, with the rook, in moderate numbers they are farmers' friends, yet if allowed to increase unduly they become equally Injurious. Their food, other than fruit, consists chiefly of wireworms and leather jackets, wood lice, millipedes, worms, snails, slugs, ground insects, and their larvæ. Mr. W. H. Neild informs me it eats the looper caterpillar of the winter moth. It takes ticks from the backs of sheep, and thus informs us that the sheep need washing. The starling is the most widely distributed of our birds, and is numerous in cultivated districts. It lays four to seven eggs, and rears two broods yearly. It appears to be acqulring an increased taste for fruit.

The Missel Thrush, which is larger than the song thrush, differs somewhat in the size and shape of spots on the breast, is less common than the song thrush, but more severe on fruit; it is a resident of Britain, and is an example of a species of bird whose distribution has become more general within comparatively recent times, as there is said to be good evidence to prove that a century ago it was either absent or very rare in many districts, particularly towards the north; it makes its nest early in the year, sometimes before the leaves are out on the trees, lays generally four, rarely five, eggs, and has two or three broods in a season, so has good opportunity to multiply. In Kent it is considered one of the worst birds with fruit, specially troublesome with cherries and soft fruit; it persistently eats pears, apples, plums, damsons, and many kinds of berries; it is fond of black currants, which most birds avoid. Its food, other than fruit, Mr. W. Swaysland, in "Familiar Wild Birds," tells us, consists of berries of mountain ash, service tree, yew, juniper, holly, ivy, hips, haws, grain, seeds of various kinds, caterpillars, beetles and other insects, worms, slugs, and snails. Aristotle mentions its fondness for mistletoe, it being almost the only bird that touches it.

Gilbert White tells us it is the largest bird of all the feathered tribe that has music in its voice; it is comparatively tame in nesting time, but most shy and wild in autumn and winter: it is one of those birds that appear to pair for life, and even when later in the year they gather in small flocks, like starlings, to attack a crop, husband and wife may be seen in close company.

Missel thrushes are good food, which is one compensation for the disagreeable task of killing them.

The Song Thrush, though resident and plentiful throughout the British Isles, is, to a great extent, a migrant, and this fact accounts for its persistent presence in gardens and orchards, when the fruit is ripe; even after large numbers have been killed, fresh arrivals take the place of the slaughtered birds; the same applies to the blackbird, though it is not perhaps so essentially a migrant as the thrush. Professor Alfred Newton tells us, that nearly all the young thrushes reared in this country, emigrate as soon as they are fit to journey, and a little later are followed by most of their parents; so that many parts of the kingdom are almost bereft of this species, from October to the end of January; whilst in other parts, examples can always be found, a considerable immigration takes place in the autumn on our east coast, by birds coming from Northern Europe; however, in most localities these newcomers depart, after a short sojourn, and are accompanied by many of the home-bred birds. The arrival of the birds in Belgium, France, and Germany is marked, by thrush shooting beginning on the 12th of August.

On the continent of Europe, the autumnal influx of the birds, bred in the North, is regarded with much interest, for they are easily ensnared, and justly esteemed for the table, while their numbers make their appearance in certain districts a matter of great importance.

Professor F. V. Theobald says the thrush is far more helpful than the blackbird; for nine months it feeds solely on snails, worms, slugs, insects and berries, only when the fruit is ripe does it become in any way a nuisance. The thrush continues its snail eating all through the summer, which the blackbird does not. Thrushes eat leather jackets in spring on clayey land; they lay four or five eggs and rear two or three broods in a season. Gilbert White mentions thrushes eating the root of Cuckoo pint in severe weather, the root being warm and pungent. The thrush family, which includes the blackbird, song, and missel thrushes, fieldfare and redwing, are reduced in numbers, through starvation, by a long and severe winter; it is twenty years or more since we have had a winter that has affected the birds severely.

The Chaffinch.—On this bird the judgement from Mr. W. E. Collinge has fallen, after due study of its habits, that, whilst not favouring ruthless destruction, it should not be protected at all.

A flock of these birds causes astonishning

harm to newly sown seed and sprouting crops, particularly to those of the cabbage, turnip and radish family, and lettuce. It is, in company with the house sparrow, a great disbudder of gooseberries, currants and plums. Mr. F. Smith says they are especially destructive after frost, when these birds will be found in twos and threes all over the plantation, eating the buds; they squeeze the blossoms of plums, cherries, gooseberries and currants, to extract the honey in them; they are also very fond of ladybirds and their larvæ, which are so beneficial in destroying green fly or aphis. Though it eats corn, it is only when its numbers are very great that it causes any serious loss to the farmer. It eats beech nuts and beech-seedlings, seeds of Scotch pine and other conifers and quantities of weed seed. It also feeds largely on insects, and brings up its young almost entirely on an insect diet; it eats caterpillars, frequently those on apple trees, and American blight or woolly aphis, also aphides on cherry, plum, damson, apple and chrysanthemum. It lays four or five eggs, and has generally two broods yearly, it is considered to be partially migratory, coming from the North in large quantities in the end of October or beginning of November.

The Greenfinch, or green linnet, is a resident, and is abundant throughout Britain, being found at all seasons of the year, particularly in cultivated or wooded districts. It appears to feed in the fields in summer, and around the farm buildings in winter. This strongly built and noisy bird needs, like the chaffinch, no protection; if anything, it is more destructive, and for a longer period. The adult birds, like the sparrow, eat but few insects; they are sometimes very destructive to sprouting crops. A field at Halstead, Kent, sowed with milled sainfoin had to be ploughed up owing to flocks of greenfinches taking all the seed. It eats grain and large quantities of weed seeds, of which it also probably distributes many. Mr. L. H. Page, of Sittingbourne, says it eats the seeds on strawberries when ripe. It does not eat fruit, but accompanies the sparrow destroying buds; it also picks some blooms to pieces. It is terribly destructive in pulling hop flowers to pieces to get at the seeds, and comes in large flocks and litters the ground with the flower bracts of the hop. It lays four to nine eggs, and has often two broods a year. Its young are chiefly fed on insects and a few soft seeds. Professor Theobald says that small winter moth larvæ and caterpillars of various injurious tortrices are fed to the young. Mr. C. F. Archibald, in his excellent articles on "Wild Birds of the Farm," in the Royal Agricultural Society's Journal, from which I have quoted with his permission in other parts of this paper, remarks, in connection with the greenfinch, that an undue increase of small birds is the inevitable result of exterminating such of their natural enemies as the sparrow-hawk, jay, and magpie.

The Hawfinch is larger than the other finches and has a notably powerful bill. It is considered to be increasing in numbers. It is sly in its habits and seldom affords opportunity for observation. It feeds on the seeds of trees, is very fond of green peas, and sometimes pecks apples and pears to get at the pips; it eats nuts and is said to be fond of damsons. In summer it captures quantities of insects, principally for its young. Mr. Archibald writes that a female hawfinch was found to contain forty caterpillars. In some localities this bird is found to be in excess.

Larks are complained of at Wrotham, Kent, as pecking early strawberries and being difficult to scare.

On light soil they eat young peas and vetches when just coming through the ground, and in cold weather come in flocks and destroy fields of cabbage and other greenstuff. The question may be asked whether the good they do in eleven months balances the harm they do in one month.

The Rook.—This bird, capable of great good and great harm, commences eating strawberries when green before one has to scare for other birds; it eats cherries, gooseberries especially in dry weather, and sometimes apples and pears; it dearly loves walnuts, also cob and filbert nuts. In the raspberry growing district at Blairgowrie in Scotland, the rook is found to be a very serious depredator, though in the Swanley district, Kent, even close to a rookery, the raspberries were not attacked. In order to keep the number of rooks under control the newly-fledged birds in a rookery should be shot, say two out of each nest, in order to make the number stationary and not increasing.

The food of rooks includes wireworms, leather jackets, slugs, snails, worms, woodlice, millipedes, and caterpillars of the Winter Turnip and other moths. Mr. W. Wood, of Crockenhill, told me that years ago, before the days of grease banding and spraying, one year, when orchards were as bare of leaf at midsummer as in winter, the winter moth caterpillar having defoliated the trees, rooks once came in large

numbers and fed plentifully on them, but he has never seen this before or since. Mr. A. Thomas of Sittingbourne mentions the rook as eating the caterpillars of the Lackey moth. On a farm, rooks are often very troublesome in disturbing and eating corn, maize, and peas, also on newly-planted and mature potatoes.

Henry VIII. dealt with the damage done by rooks to corn and grain at seedtime and harvest, and enacted "that everyone should do his best to destroy rooks, crows, and choughs, upon pain of amercement, and that every hamlet should provide and maintain crow nets for ten years, and that the taker of the crows should have after the rate of 2d. per dozen" (about equal to a present value of 4d. per crow).

The Jackdaw does little injury to fruit, is partial to cherries, destroys many insects including wire worms.

The Magpie eats cherries, but is rare; valuable in destroying the wood pigeon.

The Jay, where a fruit plantation is near a wood, is apt to peck and disfigure apples; it takes nuts, is fond of green peas and plums, and is said to feed on ripe cherries. It eats the eggs of the blackbird and wood-pigeon, and is useful in this way. Its food consists of acorns, beech-nuts, worms, snails, slugs, cockchafers, beetles, insect larvæ, mice, eggs and young birds. This beautiful and sprightly bird is becoming rare, owing to its persecution by the game-keeper.

The Wood Pigeon and *Stock Dove* are no friends to the farmers, and are seriously increasing in numbers in some districts, as besides our native species, immense flights arrive on the east coast from the continent, during the winter. Professor Theobald says these, although smaller, do the most harm. The close preservation of wood harbours the wood pigeon, which feeds on beech mast, acorns, grain, vetches, peas, young shoots of turnip tops, white clover, and occasionally garden crops, including beet and lettuce; in the woods it eats the seeds, buds, catkins of trees, and by its weight breaks the leaders of Douglas fir, silver fir and spruce. Its food is entirely vegetable, it does not assist in the destruction of insects. These wary birds will eat a whole field of cabbage in winter; they eat cherries from green to ripe, and I had a complaint from Pershore that this year the wood pigeons, or coifs as they call them there, were a plague and took the gooseberries whole. This bird should be decreased in numbers, it is good food and worth 1s. per brace. One fruit grower near Maidstone described the bird "Bad, except in a pie."

BIRDS RATHER OR DECIDEDLY USEFUL.

The Tits.—Of these beautiful and restless little birds we have six species, all resident in Britain, as they feed mainly on insect life; they are among the most useful of our small birds in the orchard; the mischief they do is comparatively small. The tits are very prolific, laying nine or ten eggs to a sitting, and have two broods in a year; they remain in company sometimes after they can fly.

The Blue Titmouse is a cheery little bird, and the most common of its tribe; it does sometimes serious damage by pecking cherries, and the sweeter flavoured apples and pears. Professor Theobald says it does more good in the orchard than any other bird; in winter it hunts amongst the boughs and twigs for woolly aphis, apple blossom weevil, aphis eggs, thrips, moths and their eggs, larvæ and chrysalides; it eats the caterpillars of the gooseberry and currant moth, the grubs of wood-boring beetles, the maggots in the round galls on oak and apparently the caterpillars of the little green oak-moth; scale insects especially apple scale, also spiders. The blue tit pulls half expanded apple and pear blossoms to pieces, apparently searching for eggs or insects. Prof. Theobald tells us that in all cases when he observed the birds on currant, pear, and apple, the buds were invaded by phytopti.

Prof. A. Newton says titmice search for food in a band, the reason apparently being that their food is collected into particular spots often far apart, but where it does occur, occuring plentifully. Thus a single titmouse searching alone might hunt for a whole day without meeting with a sufficiency, while if a dozen are united by the same motive it is hardly possible for the place in which the food is lodged to escape their detection, and when found a few call notes from the lucky finder are enough to assemble the whole company to share the feast. At Evesham it is said that tits take the moths from the grease bands on the trees. They are mentioned as eating winter and codlin moths, and are believed to eat winter moth caterpillars.

The Great Tit, or Tomtit also harms pears and apples, by pecking them at the base near the stalk, but he is said to prefer sunflower seed to this, and I know two large fruit growers, who have grown sunflowers in their plantations with the object of alluring

them from the fruit, and I believe with success. Gilbert White mentions their fondness for sunflower seeds. In the case of the great tit, insects do not constitute the whole of its diet, for yew berries, the kernels of beech mast, and hazel nuts, and other vegetable food, come under notice. Like the blue tit, it sometimes eats bees during winter; it has a habit of pulling straws out of thatch in order to get insects; it does not disdain grain.

The Cole Tit inhabits pine plantations, but also comes to fruit plantations. Mr. F. Smith says it destroys black-currant buds when they are opening, he finds it worse than the blue tit at the pears and apples, but adds, that for several years he has saved his fruit in the garden, by planting sunflowers; if there is enough sunflower seed they will not touch fruit. He goes on to say in reference to the tits, that they frequently peck the bunches of pear and apple blossom buds, just before they open, and in all cases he has examined, they contained the larvæ of some insect; the tits eat the caterpillar and chrysalis of the Bud moth.

The Long-tailed Tit feeds almost entirely on "looper" caterpillars, beetles, scale and other small insects, of which it is able to obtain an abundant supply, even in winter. Mr. George Abbey says it consumes countless numbers of aphis eggs, and he has known it clear a plantation of black currants completely of black aphides.

The Robin Red-breast, this most familiar and favoured bird, is generally distributed throughout England. Its food consists principally of earthworms, small slugs, spiders, wood lice, beetles (including the grubs of the May bug), moths and butterflies, and caterpillars (including larvæ of the Swift moth), and, in the winter, chrysalides, fastened to the twigs of trees and their trunks, and to palings, and in the walls. It eats a few red currants and cherries, and in a glass-house will peck and eat grapes; of the wild berries it eats those of ivy, honeysuckle, spindlewood, and deadly nightshade. Young robins may be seen hunting for insects under gooseberry bushes and raspberries.

Professor Newton tells us, that although the robin is resident, its numbers are subject to very considerable variation, according to the season of the year. At no time do the robins collect in bands; but towards the end of summer they may be seen in the south of England successively passing onward, the travellers being mostly, if not wholly, young birds; and so the great majority disappear, departing it may be safely presumed for more southern countries, since a few weeks later the markets of most towns, first in France and then in Italy, are well supplied with this species.

The Hedge Sparrow, Accentor, or Shufflewing, belongs to a different family, though about the size of the house sparrow. It has a more slender and pointed beak like the robin, which it is similar to in its food. It is one of the commonest yet most valuable birds in the garden, field or wood. Its food consists of worms, insects in various stages, seeds of grass and other plants, and, in hard weather, of bread crumbs and scraps from houses; the young are fed largely on caterpillars. This amiable, unobtrusive, and harmless bird deserves protection and support. It is said to be fond of bullaces. I have no mention of other fruit that it eats.

The Redstart is a migratory bird, arriving in this country about the beginning of April. Its food is almost entirely insectivorous, and consists chiefly of ants and their eggs, flies, moths, spiders, caterpillars, worms, and beetles. It is never known to touch fruit; it builds its nest in orchards and about houses.

The Tree-creeper is an active little bird with a slender curved beak. Its curved claws and stiff pointed tail enable it to ascend the trunk and branches of trees with ease and rapidity as it searches for the spiders, caterpillars, beetles, and other insects hidden in the bark. It is most useful in orchards; it eats scale. In searching for food, it will begin at the bottom of a mossy wall and work upwards, or at the foot of a tree and work its way up in a spiral direction.

The Pied Wagtail.—This graceful bird is a resident, but subject to partial migration. It feeds almost entirely upon insects, and is frequently seen following the plough. Mr. W. H. Neild places aphis amongst its food. It is a friend to the farmer in eating the water snails that act as host to the liver fluke, so fatal to sheep. Nothing but good can be said of the plover, swallow, martin, and swift, but they do not, as a rule, directly affect fruit cultivation.

The Wren.—This active, fearless little bird, which braves the winter of the British Isles and daily sings its lively song, save in severest frost, is entirely blameless; its food consists of various insects, including aphides, woodlice, also small wild seeds, and it feeds its numerous family on green caterpillars from fruit trees.

The Golden Crested Wren devours scale insects readily.

The Nuthatch is a resident common in the woods of southern and central England; it is considered to be becoming rarer. Mr. O. V. Aplin attributes this to starlings turning them out of the holes in trees they have chosen for their nest. This bird feeds on insects, beech mast, acorns, and is very partial to hazel nuts; it also eats hard seeds. It has sharp claws, and runs up and down the trunks and branches of trees with equal facility. This is a most useful bird except perhaps in nut plantations.

The Common or Spotted Flycatcher is of all our summer visitors the most mute, and the most familiar; it also appears the last of any, arriving about the first week of May from its winter quarters in Africa. Its food consists of insects captured on the wing; sawflies are a favourite food, large moths (such as the yellow underwing), white butterflies, flies, beetles and aphides; in autumn, it sometimes eats berries. It is generally distributed about England during summer, and is one of the few species which nest in the London parks and gardens. It has been accused of eating cherries and raspberries, dissection, however, has proved that the attraction is not the fruit itself, but the living creatures which are to be found upon it. The services of the spotted flycatcher, in destroying swarms of insects, many of which either plague ourselves or injure our crops, are not marred by any mischievous propensities. The birds should therefore be encouraged, and their nests and eggs carefully protected.

The Warblers, which include the whitethroat, lesser whitethroat, blackcap, garden warbler, wood wren, willow wren, and chiffchaff, come to us in spring from the South of Europe and Africa; the males usually arriving some days before the females.

The Whitethroat or Nettlecreeper is perhaps the best known and most widely distributed, it feeds on a quantity of caterpillars, aphides, and other garden pests, but in July and August the birds bring their broods into gardens and orchards, and make havoc among the currants and raspberries; it also eats green peas and pecks green gooseberries.

The Blackcap is larger than the whitethroat; an occasional one will stay the winter. Mr. F. Smith says of it: "A family of blackcaps in a cherry orchard commit great havoc. They do not eat a quarter of the fruit they pick, they are also very fond of raspberries and figs. It is the worst summer bird we have in the fruit plantations, and I think the only one of our summer visitors that does much mischief.

The Garden Warbler confines his attacks on fruit, to late cherries, raspberries and currants; it is very fond of the caterpillars of the white cabbage butterfly.

Mr. C. F. Archibald writes of the smaller warblers (the wood and willow wren,) "if ever they touch fruit, it is certainly exceptional, and for practical purposes, it is safe to say, that the benefit derived from their presence is not the least detracted by any loss of garden produce."

The Cuckoo is a soft-billed insectivorous bird, which lays its egg, or places it, in the nest of other insect-feeding birds. Buffon says of it, where the cuckoo retreats to in winter is not known, to what country it retires, or whether it has ever been seen on its journey, are questions that we are wholly incapable of resolving. Its habits are described thus "In April, come, he will; in May, he sings all day; in June, he changes his tune; in July, away he will fly; in August go he must."

The cuckoo's food is largely caterpillars, hairy caterpillar like the Ermine moth and "woolly bear," avoided by other birds; also gooseberry caterpillars, apparently both of the magpie moth and sawfly, the latter, even ducks will not eat. Cuckoos are not so numerous as one might judge from the sound they make, and so they do not affect these pests much. It also eats flies, beetles, grasshoppers and snails, but its chief food is caterpillars. F. Norgate gives instances where destructive visitations of *Bombyx pini* and *Liparis chrysorrhea* have been checked by these birds.

The Wryneck, cuckoo's mate or leader, arrives a day or two before the cuckoo: its food is ants and their eggs, caterpillars and insects on bark; the bird appears to form a link between the woodpecker and cuckoo families; it is not numerous.

The Woodpeckers are useful in an orchard. They eat the Goat moth caterpillars which injure fruit trees, though chiefly eating insects in decayed wood. The green woodpecker, which is the commonest, eats ants and their eggs, the larvæ of the bark beetles, especially those of the elm bark beetle (*Scolytus destructor*). The great spotted woodpecker eats scale insects. The woodpeckers do not eat our cultivated fruits. The greater and lesser spotted woodpeckers feed chiefly on larvæ in decaying wood and on wild fruits and berries.

The Plover eats slugs and frequents the large strawberry fields in Herefordshire in autumn and winter, and is considered to feed on the small black slug which infests the strawberry plants; these enormous flocks of peewits are encouraged and never disturbed by the owners.

The Nightjar captures insects on the wing at dusk.

The hawks and owls need all the protection and encouragement possible from the fruit-grower.

The Kestrel Hawk is one of the most useful birds we have. By far the greater portion of its food consists of field mice and beetles, including the destructive cockchafer. It also eats young rats, moles, weasels, small birds, lizards, and frogs. It is only an occasional bird that interferes with game, but this is rare. Canon Tristram mentions that one of these birds contained 178 wireworms. Mr. George Smith, of Maidstone, writes:—

"What we want in the country is to get strong protection for our good old friend the kestrel, now, I am sorry to say, rapidly disappearing. I have observed him for sixty years, and rarely indeed has he been caught in any mischief; his food is mice and beetles, occasionally a lark or small bird. The same with regard to the barn owl most emphatically."

The Sparrow-hawk eats many injurious insects, including the destructive crane-fly. It destroys wood-pigeons and blackbirds, of which we have far too many, and is one of the most efficient means of keeping the number of small birds within bounds. Moreover, its presence is beneficial in scaring birds off ripening corn. W. Swaysland tells us it has been calculated that a sparrow-hawk destroys on an average about three birds per day, and this would give a total of over 2,000 birds annually for every pair of sparrow-hawks; unfortunately sparrow-hawks are somewhat liable to take game and poultry, but as a total are very useful birds.

The Barn Owl is a most valuable mouse killer, nine-tenths of its food appears to consist of mice; the number it catches is wonderful. In 1,124 pellets examined by Mr. L. E. Adams, remains of 2,397 mice and rats, and 97 sparrows were found.

The Tawny Owl as well as the short-eared and long-eared owls should be strictly preserved; its food consists largely of rats, mice, also water rats, young rabbits, squirrels, small birds, fish, whilst beetles, including the destructive cockchafer, are sometimes devoured by it in great numbers.

SUMMARY.

Mr. W. E. Collinge, the Honorary Secretary of the Association of Economic Biology, in his report for 1905, issues a *Summary.* He strongly advocates the most stringent measures for exterminating house sparrows, wood-pigeons, and stock-doves as being distinctly injurious. He is strongly in favour of permitting (indeed encouraging) the taking of the eggs of the chaffinch, greenfinch and bullfinch. The remaining species are, in his opinion, beneficial, provided they are not permitted to increase unduly. I would add in fruit-growing districts, besides reducing the numbers of the birds already named, it may be absolutely necessary to decrease the number of blackbirds, starlings, and, more reluctantly, of the missel and song thrushes, also of the rook in districts where it interferes with fruit. In the case of hawks (particularly the kestrel), and of owls (particularly the barn owl), swallows, flycatchers, wagtails, and all such birds, no effort should be spared to protect and encourage them, and every inducement offered to them to increase in number. It is the duty of those who own woods to check the undue increase of wood pigeons, and of those who own rookeries to shoot a proportion of the young rooks to keep the numbers stationary.

In conclusion I have to thank very heartily the gentlemen, nearly fifty in number, who have most kindly filled in the forms I sent out with their experience as to the food of birds, and their influence on insects injurious to fruit. One thing these answers prove is that many fruit growers and farmers are keen observers of the habits of birds, and do not kill birds without good reason.

DISCUSSION.

Mr. H. E. DRESSER, F.Z.S., F.L.S., speaking as a fruit grower and a naturalist, said in his experience the rook did not do any harm in orchards except to walnut trees. The titmouses did comparatively little harm, except in the way of picking the base of apples and pears, but the wasps started where they left off, and created the great damage which ensued. On the whole he thought the titmouse did far more good than harm. The best destroyers of wasps were the honeybuzzards, which were almost extinct in England.

Mr. BUNYARD stated that, having been bred and born in the fruit industry, and being connected with a very large fruit-growing firm, his experience was

that the balance was by far in favour of the bird. He was sorry to say, however, that he had to place the bullfinch on the black list. During the last two or three years he had carefully dissected the crops and stomachs of some 50 or 60 bullfinches, and he found in nearly every case the contents consisted entirely of buds of fruit trees, more especially of the gooseberry. With regard to tits, he bore out what the last speaker had said—tits did attack apples and pears, and, unfortunately, they did not confine themselves to one particular fruit. He had known cases where the tits had attacked every pear on a tree, by pecking a little out of the top of the pear, and the wasps immediately took advantage of that, with the result that the pear became practically useless. That, he thought, was about the only case in which fruit growers could fall out with tits. There was no doubt that the warblers were nearly all insectivorous. The author had made a remark in regard to the cuckoo using its instinct to choose the nest of an insectivorous bird for depositing its egg, but that was not always the case. He had found eggs of the cuckoo in the nests of the greenfinch, bullfinch, and linnet, and he knew of a case quite recently where it was not only found in the hawfinch but also in the nest of a great tit. He thought that was a record, but perhaps the explanation of it was that the egg was placed in the nest of a great tit which had built its nest in a nesting-box. Very little could be said against the chaffinch. There was no doubt that all the birds Mr. Hooper had mentioned did an enormous amount of harm. He was quite convinced that the sparrow, during the time it had a brood of young, ate very little vegetable food. He had examined the stomachs of sparrows during that time, and quite failed to find anything in the way of vegetable matter, and therefore he thought it must be admitted that a great many of these birds did as much good as they did harm. Owing to the Wild Birds Protection Act a great many wild birds had increased largely, and consequently had become pests. Therefore he must say openly and without prejudice, though he was a great lover of birds, that he considered the sparrow, the starling, and the bullfinch, and some of the gulls, should certainly be taken off the Wild Birds Protection Act list.

Mr. ERNEST BELL felt a good deal of sympathy with Mr. Hooper in his difficulty in understanding the law with regard to birds. He recommended him not to take a policeman into his confidence, because it always resulted in confusion worse confounded. In his opinion the paper had been misnamed; it ought to have been called "Fruit Growing and the Unprotected Birds," instead of "Fruit Growing and Bird Protection," because not a single bird the author had mentioned was protected, or ever had been protected, by English law. He had received a letter from Mr. Meade-Waldo, of Hever, Kent, saying that he could not attend the meeting, and trusted that someone who understood bird protection, with relation to fruit culture, would be able to do so, and point out that no single bird, injurious to either fruit culture or agriculture was, or ever had been, protected by any law, and that the cause of the undue increase in blackbirds, thrushes &c., was due primarily to an absolute immunity from hard winters for eleven years, to the great reduction especially in the number of jays and other more or less predatory birds, and game preserving generally; also in the neighbourhood of towns to the large extent of villa gardens which were now growing up and affording abundant covert, and, in many cases, protection. It seemed impossible to knock into the heads of fruit growers the fact that the injurious birds were not protected. He had been that afternoon to the office of the Birds Protection Society, to find out exactly what the letter meant, and had ascertained that none of the birds which were accused of being injurious were protected by the law. He had with him a schedule of the protected birds, and it did not contain a single instance of a bird which had been mentioned that evening as injurious to fruit culture. Though they were not protected by law, there was a provision which allowed Boroughs and County Councils to give them a certain amount of protection. The only place in which the blackbird had been partially protected was in the Orkney Islands; the thrush was partially protected in two counties, but the starling and sparrow were not protected at all. The County Council protection was very partial, because even when the birds were on the list, the owner of the property had the right to kill them or take their eggs at any time. If fruit growers found they were injurious to fruit trees, they were at perfect liberty to kill them. What was really required was not less bird protection but more bird protection, especially of the sparrow hawk, the kestrel, the jay, and birds of that description, which tended to keep down the numbers of injurious birds when they increased too much. He had made his remarks because there was a general feeling that birds were protected too much in England, and it would be a great pity if that opinion went abroad, because the law was a most moderate one, and did not protect any birds against which fruit growers had a particular spite. He readily admitted that some birds were injurious to fruit growers, but cautioned them against indiscriminate destruction, because in countries on the Continent, where the extermination of birds had been attempted, it had been found that the plague of insects was very much more injurious to crops than the plague of birds ever had been, or was likely to be.

The CHAIRMAN desired to correct the remarks Mr. Bell had made with regard to the Act for the Protection of Wild Birds. It was quite a mistake to suppose that any birds were unprotected. He had gone very carefully into the question, because he was a member of the Departmental Committee appointed in connection with fruit culture; and Mr. Clarke, the legal adviser to the Board of Agriculture, gave a very clear exposition to the Committee of the Acts of Parliament dealing with wild bird protection. Those who were

interested in the matter should read the minutes of Mr. Clarke's evidence. The Act said that "Any person who between the first day of March and the last day of August shall knowingly and wilfully shoot or attempt to shoot, or shall use any line, trap, snare, net, or other instrument for the purpose of taking any wild bird, or shall expose for sale any wild bird included in the annexed schedule, shall forfeit £1 for a first offence, and in the case of any other wild bird (which included everything which was not scheduled) shall, for the first offence, be reprimanded, and discharged on payment of costs, and for every subsequent offence forfeit and pay for every such wild bird (in respect of which an offence is committed), a sum of money not exceeding 5s. in addition to the costs." That protected certain birds absolutely, and other birds partially. There was a saving clause at the end of the section saying, "This section shall not apply to the owner or occupier of any land, or to any person authorised by the owner or occupier of any land, killing or taking any wild bird on such land, not included in the schedule." It would, therefore, be seen that the unscheduled birds were protected from the public, but were not protected from the land occupier. He also desired to point out that the County Councils, whose duty it was to publish notices under the Act, had the power to modify the schedule, and if they did so they were under obligation to notify the fact in the county. Some of the County Councils gave those notifications in a manner most deleterious to the interests of fruit growers. They quoted the words of the Act, saying that all birds were protected under a penalty, and there they stopped, and did not go on to quote that the Act did not apply to the owner or occupier of the land. The chief objection to such a notice, was that the land owner thought he had no right whatever to kill the birds, and that the Act was unjust towards him. The result would be that, sooner or later, there would be a very great outcry against the Acts; whereas, if they were properly interpreted and acted upon, they would be perfectly fair both to the land occupier and to those who desired to protect useful and interesting birds.

Mr. BUNYARD said that, from his experience of fruit growers, they did not hesitate for one moment to shoot birds which were doing them harm. He believed Mr. Hooper sent a query to the *Horticultural Journal* not long ago as to the food of the blackbird. It was well known that the thrush ate snails in large quantities, but it was a moot point whether the blackbirds did. Having seen the query in the *Zoologist*, and being struck with the fact that very few people could answer the question straight off, he made inquiries among his horticultural friends, and not one of them could tell him they had seen a blackbird eating a snail. He spent his last summer holidays at a farmhouse in Kent, and, on looking out of the bedroom window one morning, he saw a blackbird on the path which he believed was eating a snail. On looking at it through his glasses his surmise was confirmed, and on going out into the garden he found the partly devoured snail lying on the path. While that was very good evidence, he did not think it could be generally said from one isolated case that blackbirds ate snails. He belived the blackbird was eating a snail in that instance because the summer was a particularly dry one, and it ate the snail for moisture. He was strengthened in that opinion, because he found the blackbirds were eating the apples in the orchards which had fallen to the ground, and had also attacked apples still hanging on the trees, which was a rather unusual thing for blackbirds to do.

Mr. MATTHEWS (Secretary, Central Chamber of Agriculture) thought that only one conclusion could be come to from the tenour of the present and many previous discussions on the bird question, namely, that there were very few people in this country who knew anything at all accurately as to what the food of birds was, and whether the good they did overbalanced the harm, or vice versa. Dr. Hollrung, of Halle, had for the last ten years been carrying out some very exhaustive experiments on the food of rooks, and during that period had carefully examined over 4,000 specimens, arriving at the conclusion that good and evil done by rooks about balanced each other. He thought it would be found that the same remark applied to many other species of birds. He was delighted to hear the Chairman's statement that he had no sympathy with those who desired to kill off all classes of birds, and he was still further relieved to hear the very open-minded remarks made by the author of the paper. It brought him back to the point from which he started, viz., that it was very necessary that an exhaustive scientific inquiry should be carried out. On one occasion he proposed that the Board ef Agriculture, or the Board of Agriture and the Home Office jointly, should appoint a scientific committee for the purpose, and those interested in the question would not be satisfied until that was done. With regard to the bullfinch, he was afraid that, superficially, a good deal of evidence could be produced against that bird. There was evidence that he destroyed many fruit buds, but there was further evidence that at certain seasons it ate a large quantity of weed seeds. Mr. Hooper had said he doubted whether this did material good, because the seeds were carried away by the birds without being digested and dropped in other places. That was a very unfair bias against the bullfinch. If that bird preferred undeveloped fruit buds, it might be assumed he would also prefer undeveloped weed seeds; and, speaking in general knowledge of the bullfinch, he knew that that was the case, particularly in the case of groundsel. The bullfinch always preferred the head of a groundsel which was only just shooting out to one that was fully developed. It was not his experience that the County Council

orders had a tendency to check the destruction of birds and the stoppage of bird nesting by school children. From personal knowledge and observation he estimated that the orders had not saved ten per cent. of the birds which children used to destroy. Birds nesting was his favourite hobby, and when he was hunting about for bird nests he still found as many nests destroyed and broken eggs lying beside the road as he used to many years ago. A paper written by Mr. Smith had been quoted a good many times in the paper, and, in referring to the starling, Mr. Smith stated that he did not think it had altered its food. If Mr. Smith made such a statement in regard to a bird which was common in every district in England, it must detract a great deal from the force of his other remarks, because he (Mr. Matthews) knew that the food and the habits of the starling had altered very considerably during the last ten or fifteen years. Mr. Aplin was the first man in this country to call attention to the fact nearly ten years ago. He therefore thought too much attention must not be paid to what Mr. Smith had said with regard to certain other species.

Captain TAILBY thought there was one point in the admirable lecture which Mr. Hooper had given from which nobody would dissent, namely the protest which had been made against the destruction of the natural enemies of many of the birds mentioned, namely, the kestrels and the owls. The harm done to game by kestrels and owls was mainly imaginary. All fruit growers agreed that kestrels and owls deserved protection. His main reason for speaking was to endeavour to get help in seeing that the Pole-trap Act was put in force. The author had read a letter in which it was stated that the correspondent knew of the existence in Kent of pole-traps at the present moment. It was the duty of the local policeman to know the law of England, which was that pole-traps were absolutely prohibited, and if he was not cognisant of the existence of such a law the sooner he was removed from his duty the better. It was lamentable that owls, which did nothing but good, should be allowed to be destroyed owing to the ignorance of local policemen. He desired to state publicly that Mr. Lemon, the Secretary of the Society for the Protection of Wild Birds, would, if he was informed of the existence of pole-traps in any particular locality undertake a prosecution. He (Capt. Tailby) would personally guarantee that this would be done.

Mr. P. F. BUNYARD replied that he knew of one place where a pole-trap was still used, but it was a modification of the pole-trap, and difficulty might be experienced in prosecuting the offender for that

Mr. J. HERDMAN desired to make a few remarks in reply to the criticisms which had been passed on the bullfinch. He knew of an apple tree in South Wilts which, in one particular year, was covered with bloom, and, at the same time, was swarming with bullfinches. The owner of the garden was a great advocate of the protection of birds, but some of his neighbours, who were energetic farmers, did not entertain quite the same opinions, and suggested that the bullfinches should be killed otherwise there would be no apples. He declined to have the bullfinches interfered with. The ground under the apple tree was strewn with buds, but the tree yielded a finer crop of apples that year than it had ever done before, the obvious inference being that the buds, which were admittedly destroyed by the bullfinches, were unhealthy buds harbouring maggots of some description. That was one point in favour of bullfinches. He had a large consignment of apples sent to him this autumn in which not a single maggot of any kind was to be found, and yet the garden in which the apples were grown were swarming with bullfinches. In his own garden he could never succeed in getting an apple which had not a maggot of some sort in it, but there were were no bullfinches, unfortunately, in his garden. He did not desire to infer in the instances he had quoted that bullfinches were at all times beneficial, but there was no doubt they were in many instances. Another interesting point was, that in his own garden last year the raspberry canes were covered up and protected from the birds. Whether due to that cause or not he could not say, but a very small quantity of fruit was the result, the greater part of it being destroyed by insects, principally caterpillars. This year the raspberry canes were not covered, with the result that a good crop, comparatively speaking, of raspberries was obtained. That seemed to be fairly sound reasoning in favour of birds. His wife, who was an enthusiastic advocate of the protection of birds, and a close observer of their habits, thought that blackbirds did eat snails in almost as great quantities as thrushes did. He thought the author had made a slight historical slip in what he had said as to the extremely interesting alteration in the habits of the kea. Mr. Hooper had said that the kea originally ate nuts, but since the introduction of sheep had changed to eating fat, first from the butcher's shop, next from dead sheep, and it now pecked through the backs of live sheep. He thought as a matter of fact, the historical sequence of the event was as follows. When sheep were first introduced into Australia, the kea, being to some extent an insectivorous bird, proceeded to eat insects off the back of sheep. By accident its beak went a little too deep, and it found that the living fat which underlay the insects, was much more palatable than the insects themselves. It then proceeded to a little further afield and ultimately found itself in the butcher's shop.

Mr. J. OWEN inquired whether it was a fact that bullfinches interfered with apple buds. So far as his

experience went they only interfered with greengage, damson, and plum trees generally and also some currant trees. He had a great number of greengage trees which year by year did not pay for the ground they stood in simply because of the destruction of the bullfinches.

Mr. BUNYARD stated he had found in his father's nursery that bullfinches did attack the buds of young apple trees.

Mr. HOOPER, in reply, said with regard to what Mr. Matthews had said about the bullfinch he wished to make a correction in his paper, namely, that the remark about the seed distribution did not apply to the bullfinch specially, but to seed-eating birds generally, and he believed Mr. Matthews was right in saying the bullfinch prefers unripe seed heads. With regard to seed distribution by birds, Mr. George Abbey had written to him as follows:—"I have mentioned weed distribution to several birds. The reason is, that I have proved that seeds pass through birds undigested. To prove that, I collected droppings, and sowed them in soil, baked to kill all life, and I was astonished to find the number and variety of seed from one ounce of droppings—not hundreds, but thousands." That did not refer specially to bullfinches. It was quite likely that the bullfinch did feed largely on vegetables, but it was really a remark which was intended for more seed-eating birds. He believed the blackbird ate apples on the ground a great deal but not so much on the tree. Amongst the birds protected in Kent which fruit growers perhaps did not approve of entirely were the chaffinch, the whitethroat, and the blackcap, the eggs of the two latter are also protected; and the starling's eggs are protected in the metropolitan district. He was delighted to hear what had been said with regard to the owl and hawk, as he did not have time to say as much as he would have liked of the splendid work those birds did—the owls in reducing the mice, which were injurious not only to the farmer but also to the fruit grower, and the hawks in keeping a check on small birds. He was glad to hear Captain Tailby say that he would take up cases where the pole-trap was in use. With regard to investigation into the food of birds, he wished to mention that the Economic Ornithology Division of the United States of America Department of Agriculture, had, during the last fifteen years, examined the stomachs of 60,000 birds, so as to be able to inform cultivators, as to what grains, weeds, seeds, wild and cultivated fruits, injurious or beneficial insects, the various birds feed upon, in order to decide whether to recommend the encouragement or destruction of each species.

The CHAIRMAN, in proposing a vote of thanks to Mr. Hooper for his interesting paper, said it was 18 years since the last Act was passed, and it was full time an inquiry was held as to its operation during that time.

The resolution of thanks having been carried unanimously, the meeting terminated.

CHINESE RAILWAYS.

The mileage of railways now in operation in China, being built and projected, including the railways constructed under the Manchurian concession, amounts to about 9,000 miles. Railways in China have been classed as commercial, political, commercial-political, and strategical. They may also be grouped according to the nationality of their concessionaires. These would be Chinese, English, German, French, Belgian, and Portuguese. The following, according to the American Consul at Nankin, are the lines which have been or are being built or projected by Chinese initiative and entirely under Chinese control:—Peking-Si-ling.—This line, extending from the capital westward to Si-ling, or the West Mausolea, is nearly 40 miles long. It was constructed by native engineers some years ago, and has since been in continual operation. Changhai-Woosung.—This line, about 12 miles long, was first constructed in 1876, under the auspices of an English firm. For a year there was a good deal of traffic, but the Chinese Government objecting to it being in the hands of foreigners, bought it in 1877, tore it up, and transferred the rails and rolling stock to Formosa. It was not until 1898 thht the Chinese Government reconstructed the line, and at present it is a great success financially. It is to be incorporated as part of the Shanghai-Soochow system. Wuhu-Sengan.—Surveying has only recently begun on this line, beginning at Wuhu, and extending 30 miles to the south-east. At present the work seems at a standstill for the want of money. The line will be built to Sengan, in northern Chekiang, 100 miles, to connect with the railway system of that province. Pingsiang-Chuchow.—This line, which at first connected the coal mines of Anyuen with Liling, a distance of 23 miles, was last year extended 29 miles farther to Chuchow. Nanchang-Kinkiang.—A concession for this line, about 100 miles long, was granted to a Chinese syndicate some years ago, but the matter lay in abeyance until recently the gentry of Kiangsi decided to proceed with the construction of the line. Chengtu-Hankow.—The building of this line was authorised some years ago. It is now stated in Chengtu that the gentry and officials of Szechuen have decided to start at once the construction of the 60 miles between Chengtu and Chiangkou, and thus begin the building of the proposed road to Hankow, which will be the great trunk line crossing the Empire from west to east, as the Peking-Canton line is to be from north to south. When completed the road will be some 700 mile

long. Changsha-Chenchow.—During the early part of 1905, a Chinese syndicate was formed, and obtained the Imperial sanction to construct a railway between Changsha and Chenchow, *viâ* Changseh, and steps are now being taken to carry the scheme into effect. These cities are large and important, commercially, lying wholly within the Hunan Province which abounds in coal. This line would be 200 miles in length. Canton-Whampoa.—Last year Imperial sanction was given to construct this line. It is only ten miles in length, but its importance lies not only in the fact that it is an initiative for a line passing through Swatow to Amoy to connect with the system of Fukien Province, but that Whampao, with its deep and magnificent harbour, might seriously affect the commercial interests of Hongkong. Amoy-Changchou.—This line, which will be about 30 miles long, is being built under the directon of the famous Lin family, formerly the millionaires of Formosa. When completed it is thought that it will be extended to Fuchau. Swatow-Chaochou.—This line connects the port of Swatow with Chaochou, the capital of the prefecture of that name. It is being constructed by Japanese contractors and all the railway materials except rails and locometives are imported from Japan. Canton-Hankow.—This line was to complete the through trunk line from Pekin to Hankow, now finished. Work on the main line has been carried about 70 miles above Canton, where it remains awaiting the settlement of a seemingly interminable struggle for dictatorship between the Viceroy at Canton, the gentry, and the merchants. Peking-Kalgan.—This line, connecting the capital with Chang-chiakon or Kalgan, a distance of 120 miles, is being built with Chinese Government capital and by Chinese engineers at an estimated cost of £900,000. It has been decided by the Government, on the recommendation of Viceroy Yuan Shih-Kai, to extend the line when finished from Kalgan to Urga, the capital of Mongolia, and thence to Kulun on the Mongolian frontier, the funds of which extension have already been provided. Chinanfu-Chenting.—The concession for building this line was originally granted to Germany but being, redeemed, preparations for its construction and the supplying of rolling stock are progressing. Hangchow-Soochow.—The gentry and people of Chekiang province have formed a company for the construction of their own railways. They have appointed a Chinese railway engineer as the chief engineer and are busily engaged in collecting capital. The first line to be built will run from Kungshun bridge, near the settlement of Hangchow, to Kiangkan on the Chentang river, a distance of fifteen miles, whence it will be pushed on to Kashing and Soochow. A wise arrangement has been made among the gentry of the five provinces, Kiangsu, Kiangsi, Anhui, Chekiang, and Fukien, by which the railways in their respective provinces when completed will have a uniform gauge of track and rolling stock, so as to form an inter-communicating system in east central China. Kaifeng-Chengchou.—This is a branch line of the Ching-hau Railway, and connects Kaifeng and Chengchou. It is 50 miles long, and is graded ready for the laying of the rails. Taiynan-Pingyao.—This line is in Shansi province, and the officials and gentry there have decided that the first railway built by them shall connect Taiynan and Pingyao, in the Fen Chou prefect ure,a distance of about 100 miles. They have also decided to build the three following lines, and have obtained the consent of the Shangpu thereto:—(1) From Tatungfu to Kalgan; (2) from Puchon to Tungkuan, in Shensi, crossing the Yellow River; and (3) from Pingyan to Tsachou, connecting with the Taokou and Tsechou Railway, which was built by the Peking Syndicate, and afterwards sold to the Chinese Government.

Dealing next with the question of British concessions, the Peking Syndicate (Anglo-Italian), by certain concessions in Shansi and Honan provinces, secured rights to construct a railway from Taiyuen, in Shansi, to Singan, the capital of Shensi, whence a line is planned parallel with the course of the Yellow River, to connect with Kai-fang, the terminus of a branch line of the Peking-Hankow Railway. The same syndicate has also undertaken to construct a line from Tsechon, on the southern boundary of its mine-fields, to Singan, 250 miles distant on the Han River. To connect the coal-fields or northern Honan, operations were begun upon a line from Chinghua to Taokou, whence the Grand Canal could be reached by the Wei River, thus having water connection with Tientsin. The line has already been completed and ballasted for 90 miles from Taokou. Peking-Newchwang.—This line, 556 miles long, is in operation. It was built with British capital, but sold a year ago to the Chinese Government. It runs from Peking to Tientsin, to which point it has a double track, thence through Tongku, Shanhaikwan, and Kinchow to Newchwang. Tientsin-Chinkiang.—This line is secured by the Anglo-German syndicate. The southern half has been apportioned to the British and Chinese Corporation, and the northern half to a German company. Soochow-Hangchow.—This line, 100 miles in length, and the Kowloon-Canton line, which is under construction and 100 miles long, are secured by the British and Chinese Corporation. The Shanghai-Woosung line is also included in the security. The length of the road is 180 miles, passing through the cities of Soochow, Wusieh, and Chinkiang. It is hoped soon to open it to public traffic as far as Soochow. As regards German concessions, in the year 1889 certain German syndicates and the German Government obtained from the Chinese Government various railway and mining concessions in the province of Shangtung. By the treaty of March 6th, 1898, the construction and maintenance of these railways were to be carried on by a German-Chinese Company, with the title of "Shantung Eisenbahn Gesellschaft." This company was formed in Berlin in June, 1898, with a capital of £2,667,000, and shortly afterwards its headquarters were transferred to Tsingtau. It was soon decided not to con-

struct the line from Chinanfu to Ichoufu, or any other point on the southern boundary of Shangtung province. The Tsingtau-Chinanfu line was constructed during the winter of 1903, and has been working ever since. It had its own postal and telegraph services until recently, when, owing to the strong representations of the Chinese Government, the separate postal service was given up to the Imperial Chinese postal service. Tientsin-Chinkiang.—In May, 1898, an agreement was entered into by which a concession was granted to the Deutsch-Asiatische Bank and the British and Chinese Corporation, represented by the Hongkong and Shanghai Banking Corporation. The northern half of the line is to be under the control of the German Bank, and the southern half is to be under the control of the Hongkong and Shanghai Bank, and is to run to Chinkiang on the Yangtse. The total length of the line is 600 miles. Chinan-Chingting.—A concession was granted to the Germans to build this line, to connect with the Peking-Hankow Railway; but the concession was recently, contemporaneously with the withdrawal of the German railway garrisons, re-sold to China for the same amount as was given for it. Taking next the French concessions. Tonquin-Yunnan.—The line is intended to connect Hanoi in Tonquin with Mengtze and Yunnanfu through the Lan River Valley, a distance of about 200 miles. The line is completed and in working as far as Yunnan. Langson-Lunchow-Nanning.—The concession for this line, which has a length of about 100 miles, was secured in 1889, but so far no work has been done on it. Pakhoi-Nanning.—Nothing has been done on this line. The distance between the two cities is about 120 miles. In the case of the Belgian concessions, the Ching-han or Peking-Hankow line which is about 800 miles in length, was authorised in 1889. The part of the line between Lu-kao-chiao and Paotingfu, some 90 miles, was built with Chinese Government capital, under the direction of British engineers. The concessionaaires of the portion from Paotingfu to Hankow were the Franco-Belgian Syndicate. At present one train leaves Peking and one from Hankow daily, and already attracts many passengers and a certain amount of goods traffic. As regards Portuguese concessions, the Macao-Samshui line is to run from Macao to Siang-shau, thence to Kong Moon and to Samshiu the terminus, where it connects with the Canton-Samshiu branch line of the Canton-Hankow railway. Unlike nearly all the other railways in China, this one will be an entirely commercial undertaking, free from all Government interference or political control. As this line will pass over the Canton and West River delta, many bridges will be necessary, rendering the undertaking a costly one. The distance is about 130 miles. Finally we come to the Chinese Imperial Railways. For the Peking-Tientsin-Shanhaikwan-Newchwang railway a loan was granted from the British and Chinese Corporation. The lines mortgaged as security, and which are in operation, are the 84 miles Peking to Tientsin, double line; 27 miles, Tientsin to Tongku, single line; and 147 miles, Tongku to Shanhaikwan, single line. The lines also in operation, but upon the earnings of which only the loan has a first charge, are the 130 miles, Shanhaikwan to Kinchow, single line, and 130 miles, Kinchow to Newchwang, thus constituting a continuous and complete railway of 526 miles, exclusive of 30 miles for sidings. It has been computed by the engineer-in-chief of the Imperial railways in North China that the capital cost of the intramural line from Peking to Shanhaikwan, a distance of 258 miles (exclusive of sidings) was £1,985,000. At Kaochiao, which means "High Bridge," and is distant 60 miles from Shanhaikwan, there is a branch line running north-westerly for 30 miles, and connecting with the Nanpiao coal mines. These mines are pronounced by experts to be the richest and most valuable coal mines in North China.

THE INDUSTRIAL CONDITION OF BOHEMIA.

Bohemia is situated in the very heart of Europe, on the highway of commerce between its northern and southern ports, and eastern and western markets, a day's distance from the former ports, and only a few hours from the principal cities of Central Europe. Bohemia is a land of extraordinary industrial activity, great agricultural wealth, considerable financial resources, and vast commercial possibilities, and all branches of education are very advanced. It has a population of 6,318,687, or about 25 per cent. of the total population of Austria. This population is about 65 per cent. Czech and 35 per cent. German. There is considerable rivalry between the two races, and this should be taken into consideration in dealing with them. The commercial men speak both languages, but, according to the American Consul at Prague, they generally prefer to be addressed in their own language, and frequently, to deal with their own nationality. Of the foreign languages spoken, French seems the most popular with the Czechs and English with the Germans, but the younger generation is learning both languages, thus speaking four—German, Czech, English, and French. Bohemia covers an area of 20,061 square miles, or about 18 per cent. of the total area of Austria. Of the seventeen divisions of the Austrian Empire, the kingdom of Bohemia ranks second in area but first in industry and commerce. It is also claimed that its land is very fertile and its people industrious. Of the population, about 40 per cent. are engaged in farming and industry; about 38 per cent. are employed in manufacturing and mining; 8 per cent. in commerce, and 9 per cent. as labourers. Only about 14 per cent. of the land is not under cultivation. About one-third of the industrial or commercial firms in Austria are established in Bohemia, representing about 37 per cent. of the

total Austrian industrial and mining industries, and about 26 per cent. of its whole commerce. At Aussig, on the Elbe, on the Saxon frontier of Bohemia, there is a rice milling industry of some importance. In the Erzgebirge district, particularly in the neighbourhood of Carlsbad, the manufacture of musical instruments has been carried on for more than a century, and has so considerably increased of late years, that it is second only in importance to the porcelain industry. Graslitz is the centre where the wind instruments are made, and Schönbach, near Wildstein, is that for stringed instruments, more especially for violins. From Graslitz wind instruments are exported all over the world. Schönbach, with a population of 5,000, is about a three hours' journey by road from Graslitz. There are in the town many manufacturers of so-called cheap violins, and a considerable quantity of these are exported annually to the neighbouring kingdom of Saxony. Coal is produced in and exported from Bohemia. Iron ore, iron graphite, silver and gold are also produced. Mining claims have been taken up by British, French, and local companies, and the gold mining industry, which for many years lay dormant in Bohemia, bids fair to become one of some importance. It may be added that Bohemia's contribution to the Imperial revenue averages about 25 per cent. of the total amount of State taxes received. On taxes levied on real property (land, houses, &c.), the proportion is 22 per cent., and in personal income taxes 23 per cent. In indirect taxes, levied on beer, alcohol, sugar, wine, tobacco, and mineral oil, the proportion was about 27 per cent., giving a fair idea of the industry, wealth, and consuming power of the population of the kingdom.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in September :—

New Charts.—3584—West Indies, channels and anchorages in the Great Bahama bank :—Man of War channel ; Cays south-east of Andros island ; Washer woman's cut. 3587—West Indies :—Haiti ; Fort Liberté bay. 3589—Chile :—Guaitecas islands. 3592—Siam :—Bangkok harbour. 3585—China, north-east coast :—Approaches to the Wusung river. 3575—Japan :—Plans on the west coast of Nipon ; Futam-Wan ; Aikawa Wan.

New Plans and Plans added.—2291—Norway, Sheet II. :—Bergen to Stav fiord. New plan :—Lerdalsöen. 219—Malacca strait : Acheh head to Diamond point. Plan added :—Gighen road. 2284—Plans of anchorages on the west coast of Sumatra. Plans added :—Sinkel road ; Sinkel creek. 2718—Anchorages on the east coast of the Celebes. New plans : — Tomini road ; Togean anchorage. Plan added :—Lambunu road. 2196—Sketch plans of anchorages in the southern part of Celebes. New plan :—Bulekomba and Bintaru roads. 651—Japan : Bungo channel. Plan added :—Amaji ko. 1176—Islands in the South Pacific. New plan :—Niue or Savage island.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—1188—The world :—Coal and telegraph chart. 3421—Scotland, west coast :—Broadford bay. 117—Faroe islands. 2300—Baltic sea :—Gulf of Bothnia, sheet V. 2526 — South America, east coast :—Buenos Aires. 1897*b*—British Columbia : — Victoria harbour. 1844—Borneo :—Labuan island. 1857—China, east coast :—Namoa island. China, north coast :—Pei ho or Peking river, sheet I. 5388—China, north coast :—Terminal head to Hai Yung tau. 2415—Japan :—Approach to Nagasaki harbour. 1079—Tasmania. New Zealand : —Port Nicholson. 3033—New Hebrides :—New Hebrides island and New Caledonia.

These charts are issued by Mr. J. D. Potter, 145, Minories.

GREEK MARBLE.

Among coloured Greek marbles of great beauty may be mentioned those of the island of Skyros ; the green marbles of Tirios ; the Cipolino marbles of Eubœa, of two shades of green that blend in broad, wavy lines, that run through the stone ; and the red marbles of Mani, known as Rosso Antico. The latter is of a blood-red colour, often traversed by veins of white, or sometimes found in solid red. According to the American Consul at Athens, a British company owns the whole of the white and blue quarries on the Penteli mountain range, and have spent money lavishly in developing them. The private railway of the company extends fifteen miles from the inclined plains of Mount Pentelikon. Blocks weighing twenty tons are taken to the company's works, whence they are conveyed to the Athens railway, a distance of about eight miles, also over a private line owned by the company. Work at the Penteli quarries is kept in full swing night and day, and about one thousand men are employed. It is the aim of the company to place marble on the market at less prohibitive prices than those which have prevailed hitherto. Blocks weighing as much as forty tons have been taken down to the port at Piræus and loaded on shipboard for export. The Penteli marble is almost pure carbonate of lime, but there is more sparkle in the crystals than is found in Italian marble. Its close texture and high purity of colour have given it an undeniable claim to its description as a "white" marble. But of all the white marbles of the world, perhaps the most beautiful is the finely grained and spotlessly pure Parian marble of the island of Paros. The celebrated statues Venus Milo, the Venus de Medici, the Venus Capitoline, were made of this marble. These quarries, as well as those of the adjoining island of Naxos, have been taken over by the same company referred to above.

HOME INDUSTRIES.

Migration.—Notwithstanding the changes in economic conditions agriculture remains the greatest of home industries, and evidence of contraction, and declining prosperity, can never be received with indifference. The Board of Agriculture has been inquiring into the decline of the agricultural population of Great Britain between the years 1881 and 1906, and it has just published its report upon the facts collected. There is nothing very novel in the evidence submitted, or the conclusions reached, but it is well to have attention directed to the facts by the highest official authority. The total number of replies received to a circular issued by the Board to their correspondents was 248, and in many cases the answers were prepared after consultation with, or reference to, a large number of persons able to afford the necessary information. It may be assumed therefore, that the evidence is fairly representative of the facts, the more so that they comprise census and other inquiries. They show that since the census returns of 1901 there has been further reduction of the men employed on farms, but that the diminution is proceeding at a slower rate than during the twenty years preceding that date. The Report says that, roughly speaking, 30 per cent. of the tillers of the soil have left the country for the town in less than a quarter of a century. In the English agricultural districts, and notwithstanding the general growth of the population, there has been a decrease of 241,152, in Wales of 11,099, in Scotland of 42,376. "Whether we assume," says the report, "that the present rate of the decline in agricultural labour is 10 or 20 per cent. per decennium, or, as is perhaps probable, something between the two, it will be granted that its continuance is a serious social and economic fact." No one will wish to dispute that. Hitherto a decaying rural population has always sapped national vitality, and there is no reason to believe that Great Britain, will be an exception to the rule. Can the migration from country to town be arrested? That is the practical question to which inquiries like that to which attention is being directed do not furnish an answer. The emptying of the countryside into the towns is a deplorable fact. Is it due altogether, or mainly, or to some extent, or not all to preventable causes? There are those who say it is due to a bad land system, and others who are equally certain that, do what Parliament may, it cannot be checked, much less stopped. Probably, as usual, the extremists are wrong, and it is impossible to stop the migration from country to town though it may be possible to lessen it.

The General Rule.—A fact of first importance in this connection is that this migration is not confined to the United Kingdom, although it may have been proportionately larger here than elsewhere. It is found in all countries. Among the older European States there is none more favourably placed for the cultivation of the soil than France. In an exceptional degree the tillers of the soil are owners of it, and in most parts of France the soil itself gives a generous return for the labour expended upon it. Yet the migration from country to town in France is large. In Germany much of the soil is poorer, but the agriculturist is protected by exceptionally high tariffs, and his interests are served often at the expense of the rest of the community, yet in Germany, which until 1870, was essentially an agricultural country, the cities are growing at the expense of the country side. And it is the same in young countries where, as a rule, the tiller is the owner of the soil, and agriculture is pursued under the most favourable conditions. The United States is still largely an agricultural country, but even there the ratio of townsmen is steadily rising, whilst in Australia, the influx from country to town is becoming a matter of serious concern to the statesmen of the Commonwealth. These facts demonstrate that the influences which tend to thin the country districts are not confined to the United Kingdom, and these influences are many. The dissemination of knowledge, and facilities for travel, are at the bottom of the movement so far as the labourer is concerned. A hundred years ago it was not uncommon for a peasant to live and die in the village in which he was born, without ever having visited a considerable town. Nowadays he thinks nothing of a hundred miles journey. The cheap newspaper gives him information of a sort, and he is attracted to the town by the promise of higher wages, greater freedom, more amusement. On the other hand, the landowner and the farmer find it increasingly difficult to derive reasonable profit from the land, and unable to make cereal crops pay, are laying down more and more land to grass with the result, as the report states, that some 2,000,000 acres have passed from arable to pasture during the last quarter of a century, throwing from 60,000 to 80,000 labourers out of employment during that period. Nor is it easy to see how, under present conditions, this state of things is to be changed. Much has been hoped from the increased cultivation of fruit, and something has been done in this direction, but only certain districts are suitable for it, and even then, as in Kent, bad seasons and foreign competition make the industry a very speculative one to growers who, like most English cultivators, are not scientific in their methods. Co-operation might do much, but the English farmer does not take readily to it, and as yet little progress has been made in that direction. And whilst the system of allotments benefits the labourer, there is little to show that even if the Legislature were willing to assist the English tenant, as it has helped the Irish, to become owner of the soil he tills, he would be much better off, or that his sons would be much more willing than they are now to remain upon the land. And of course manual labour is being more and more displaced in consequence of the greatly extended use of drills, horse hoes, mowers, binders, manure distributors, and the like. What with the competition of the foreigner,

the displacement of hand labour by machinery, and the attractions of the towns, the problem to be solved is of the utmost difficulty.

Cotton Supply.—Very hopeful statements as to the expansion of cotton growth within the Empire were made at the annual banquet of the British Cotton Growing Association held last week. There has been a considerable addition to the imports of what may be called Empire-grown cotton this year, and there is ground for the belief that there will be even more rapid advance next year. The need for it grows more apparent every year. By far the larger quantity of cotton produced still comes from the United States, and the home demand increases yearly, whilst much of the exported article goes to the continent of Europe. A few years ago the American consumption of cotton was almost *nil*. Last year the domestic grown cotton retained for consumption amounted to 2,689,432,828 lbs. Ten years ago the per-centage of American domestic product exported was 70·59 per cent., last year it was only 61·55 per cent; and at the present time there is great activity in the Southern States in the building of new mills and the enlargement of old ones. The total number of new mills built during the year ended August 31st last was 22, representing 113,814 spindles. It is true that 14 cotton mills in the South ceased operations in the same period, but the machinery of those mills was practically obsolete, whereas the new mills are splendidly equipped. At the present time the total number of mills in operation in the Southern States is 675; they contain in the aggregate 9,300,000 spindles, and some 190,000 looms. With the new mills, which will begin running next year, the total number of spindles will be roughly 10,000,000, and of looms over 200,000. The additions and enlargements now being made to plants in existence will add another 400,000 spindles before the end of next year. At present the Southern mills in operation are taking about 2,400,000 bales of the annual crop, and when all the plants now in course of erection are at work this quantity will be increased to 3,000,000 bales, or more than 25 per cent. of the total production. And these figures cover the Southern States only. If the expansion is less rapid in the New England States it is still considerable, and promises to continue. Last year the American exports to China were nearly 500,000,000 yards; 79,500,000 yards were sold in the West Indies; and the trade with South America promises rapid growth. Nearly all the American export trade has been developed during the past few years, and whilst the home demand in the United States is growing with great rapidity, the continental demand for the raw material grows larger yearly. Half a century ago the continental demand was insignificant. The contrast between then and now is indicated in the following figures taken from the Statistical Abstract for the principal and other foreign countries just issued (Cd. 3136:—

	1850. lbs.		1905. lbs.
United Kingdom	431,531,091	..	1,983,626,885
France	125,134,091	..	409,151,840
Germany	38,552	..	1,005,839,498
Belgium........	..	..	72,711,991
Russia	4,338,705	..	64,530,059
Spain..........	..	..	147,768,715
Italy	..	..	267,367,731
Total European importation ..	635,381,604	..	4,304,848,900

In 1850, the United Kingdom took over two-thirds of the total American output of cotton to Europe; in 1905 considerably less than half; whilst Germany, which only took 77 bales in 1850, last year took 2,011,675 bales.

Shipbuilding.—The figures which give the tonnage of new shipping built in Scotland for the eleven months ended November 30th, are very remarkable. 1905 was a record year, but considerably more tonnage has been put into the water in the eleven months of 1906 than in the whole of last year, the figures being 603,920 tons, as against 587,930 tons. The average size of the ships has risen considerably, as whilst 16,000 more tons has been floated during the eleven months than in the twelve of 1905, 412 vessels were floated in the latter year, as against 391 in 1906. This average is, however, somewhat deceptive, seeing that it has been increased considerably by the launching of three or four exceptionally large ships. The contrast in the output is not fully represented by the figures given above, because in addition a large number of the smaller class of vessels, and the light draught class, usually shipped abroad in pieces, do not figure in any monthly statements, but are included in the complete returns for the year, so that by the end of December both the number of vessels and the aggregate tonnage will be considerably higher. It is estimated that with the vessels still to be launched, and with the addition of the figures of the "shipped" tonnage, the total output of the year will be very nearly 600,000 tons for the Clyde alone, an excess of 60,000 tons over that of last year. And this notwithstanding the strike.

Iron and Steel.—Last week, Cleveland pig iron rose to 63s. 6d., and at the time of writing it is 63s. 3d. West Coast hematite showed even a bigger rise, at 77s. 9d. On the North-East Coast, steel makers have advanced the price of plates 5s. per ton. Scotch hematite has also appreciated 4s. a ton on the week, and 8s. a ton on the month, at 80s., and even at that price, makers will not part with any quantity. The probability of a shortage in the supplies of hematite iron in this country has alarmed consumers, and the foreigner is ready to pay the price demanded. Home consumers are in an awkward position, for they cannot get a corresponding advance in the manufactured article. All the indications tend to show there will soon be serious deficiencies in the supplies of iron and

steel. The foreign demand is assuming unexampled proportions. The President of the Canadian Pacific Railway Company recently said that his company would gladly buy 10,000,000 dollars worth of cars and locomotives if they could be obtained. The manager of the Paris, Lyons, and Mediteranean Railway Company again has assured the Paris Chamber of Commerce that it would take a year to produce a stock of 1,000 railway waggons now much wanted by the company. There are large contracts in abeyance for the Far East, Canada, South America, and Southern Europe. Altogether it is an anxious time for steelmakers and hematite users, the outlook being anything but clear.

Our Foreign Trade.—The trade and navigation returns for November are among the most satisfactory of a wonderful year. The increase in imports of "raw materials and articles mainly manufactured" is no less than £2,721,054, and allowing £504,746 for decrease in food, drink, and tobacco, and £15,457 unclassified, the total increase in imports is £2,601,934." Our imports of raw cotton were larger by 38 per cent. in value and 24·9 in quantity than for the corresponding month of last year. So with the exports. The total increase for the month was £3,367,013, and of this no less than £2,557,839 comes under the head of "articles wholly or mainly manfactured." Of course the shipments of iron and steel show a large increase, but it is to be noted that the improvement is spread over every class of manufactures wtth the exception of electrical goods, machinery, new ships, and apparel. Taking the eleven months to November 30, the percentage in the imports has risen 8 per cent, and in exports 14·2 per cent. It is a wonderful record, but this country is not exceptional in the great expansion of its trade during the present year. To take our most formidable competitor, Germany, the German foreign trade statistics for October, the latest available, show that imports amounted to 6,347,000 tons, as against 5,239,000 tons in October, 1905, and exports 4,040,000 tons, as against 3,814,000 tons in the corresponding month of last year, and the full extent of the increase is not reflected in these figures, seeing that a large number of articles are no longer measured by weight, and so are not included in the general totals.

CORRESPONDENCE.

OBJECTIONS TO THE COMPULSORY INTRODUCTION OF THE METRIC SYSTEM.

It gave me much pleasure to be present at the Society's meeting on Wednesday last, when Sir Charles Watson read his excellent paper on the Metric System. Unfortunately the two hours at the disposal of the chairman were too short to allow of all those being heard who desired to speak to the paper, and the few remarks I ventured to make were perforce hurried and incomplete. May I therefore be permitted to supplement them by stating that I almost entirely agree with Sir Charles Watson in his arguments against the *compulsory* employment of metric weights and measures and the *prohibition* of the use of our present standards, which, in my view, are the natural selection of the people; with the refinements and adjustments, to suit different trades, which the experience of many centuries has brought about. A radical change, everyone must allow, will be most serious to all concerned, more serious probably than the advocates of the change thoroughly realise. Be this as it may, my desire is to emphasise the fact that after 112 years' experience, France—the initiator of the metric system—can only maintain its legal use by the constant coercion of the Government. The countries which have recently adopted the metric system can hardly be expected to be quite unbiassed in their notions, as the novelty has not yet worn off, and the bureaucrats who introduced the system cannot, if they would, belie a judgment they have comparatively recently given. I, therefore, confine myself to what occurs in France at the present day. I believe everyone who has an intimate knowledge of that country will support me in stating that the metric and decimal system is used there as little as it possibly can be. Precious stones are to-day bought and sold in carats; firewood in cordes; milk in pintes; gravel in toises; grain, potatoes and charcoal in boisseaux; wine in barriques, feuillettes, demi-setiers, and chopines; wood for construction in pieds, pouces and lignes; beer in canettes and pots; sugar and coffee among the poor people is dealt with in livres, demi livres, &c. Cattle dealing is carried on in pistoles and écus and not in francs. I might also refer to the Millerolle of Southern France, the "Charge de Blé," the botte, the sack of flour of, I think, 157 kilogrammes, and a hundred others, but the quotations I make will serve for my argument.

The fact is, the inordinate desire to preserve a ratio of multiples and sub-multiples of ten between the different units has destroyed the usefulness of these units for universal employment. The French people recognise this, and adopt for their trades and industries other weights and measures for every-day use. These they convert into the legal standards when a question of contract arises.

As the chairman read a communication from Lord Kelvin, may I be permitted to reproduce an opinion expressed some ten years ago by one of our recognised clear-thinking men. Herbert Spencer said:—

"From one, who every month has to act as auditor, I have received a letter in which he says:—'I had to go over more than £20,000 of accounts yesterday, and was very thankful that it was not in francs.' This statement coming from a man of business, has suggested to me the question—By whose advice is it that the metric system of weights, measures and

values is to be adopted? Is it by the advice of those who spend their lives in weighing and measuring and receiving payments for goods? Is it that the men who alone are concerned in portioning out commodities of one or other kind to customers and who have every minute need for using this or that division or sub-division of weights or measures, have demanded to use the decimal system? Far from it. I venture to say that in no case has the retail trader been consulted. There lies before me an imposing list of the countries that have followed the lead of France. It is headed 'Progress of the Metric System.' It might fitly have been headed 'Progress of Bureaucratic Coercion.' When fifty years after its nominal establishment in France, the metric system was made compulsory, it was not because those who had to measure out commodities over the counter wished to use it, but because the Government commanded them to do so; and when it was adopted in Germany under the Bismarckian *régime*, we may be sure that the opinions of shopkeepers were not asked. Similarly elsewhere, its adoption has resulted from the official will, and not from the popular will.

"Why has this happened? For an answer we must go back to the time of the French Revolution, when scientific men were entrusted with the task of forming a rational system of weights, measures and values for universal use. The idea was a great one, and, allowing for the fundamental defect on which I have been insisting* it was admirably carried out. As this defect does not diminish its great convenience for scientific purposes, the system has been gradually adopted by scientific men all over the world, the great advantage being that measurements registered by a scientific man of one nation are without any trouble made intelligible to men of other nations.

"Evidently moved by the desire for human welfare at large, scientific men have been of late years urging that the metric system should be made universal, in the belief that immense advantages, like they themselves find, will be found by all who are engaged in trade. Here comes in the error. They have identified two quite different requirements. For what purpose does the man of science use the metric system? For processes of measurement. For what purpose is the trader to use it? For processes of measurement plus processes of exchange. This additional element alters the problem essentially. It matters not to a chemist whether the volumes he specifies in cubic-centimetres or the weights he gives in grammes, are or are not easily divided with exactness. Whether the quantity of liquids or gases which the physicist states in litres can or cannot be readily divided into aliquot parts is indifferent. And to the morphologist or microscopist who write down dimensions in sub-divisions of the metre, the easy divisibility of the lengths he states is utterly irrelevant. But it is far otherwise with the man who all day long has to portion out commodities to customers and receive money in return. To satisfy the various wants of those multitudes whose purchases are in small quantities, he needs measures that fall into easy divisions and a coinage which facilitates calculation and the giving of change. Force him to do his business in tenths and he will inevitably be impeded.

"'But you forget that the metric system is approved by many mercantile men, and that its adoption is urged by Chambers of Commerce.' No, I have not forgotten; and if I had I should have been reminded of the fact by the fears now expressed that our commerce will suffer if we do not follow in the steps of sundry other nations. The fears are absurd. French and German merchants when sending goods to England, find no difficulty in marking them or invoicing them in English measures. And if English merchants imply that they are too stupid to follow the example in a converse way, they can scarcely expect to be believed."

ROBERT KAYE GRAY.

106, Cannon-street, London, E.C.
December 7th, 1906.

* Spencer here refers to the adoption of the decimal in lieu of the duodecimal system.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

DECEMBER 19.—"Modern Developments of Flour-Milling." By ALBERT E. HUMPHRIES, President of the Incorporated Association of British and Irish Millers. PROFESSOR THOMAS HUDSON MIDDLETON, M.A., will preside.

JANUARY 16, 1907.—Adjourned Discussion on Mr. J. W. GORDON'S paper, on "Patent-law Reform." SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

JANUARY 23.—"The Straits of Panama." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company. SIR JOHN WOLFE-BARRY, K.C.B., F.R.S., will preside.

JANUARY 30.—"Apprenticeship." By JAMES PARSONS, M.A. SIR WILLIAM BOUSFIELD, M.A., LL.D. will preside.

Dates to be hereafter announced:—

"The Principles and Practice of Insurance, and their modern Developments." By THOMAS EMLEY YOUNG, B.A., Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association.

"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Engraving and Photogravure." By. J. CRAIG ANNAN.

"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

"Cold Storage and Food Supply." By HAL WILLIAMS.

"Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts.

"Motor Omnibuses." By LORD MONTAGU OF BEAULIEU.

"Joinery and Cabinet Making." By A. ROMNEY GREEN.

"Oils, Varnishes and Mediums." By ARTHUR P. LAURIE, M.A., D.Sc., F.R.S.E.

"Sheffield and Electro-plate." By SHERARD COWPER-COLES.

"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G.

"The City of Madras." By SIR JAMES THOMSON, K.C.S.I.

"The Applicability to Indian Rivers of the Italian System of dealing with Silt." By SIR EDWARD C. BUCK, K.C.S.I.

"The Kent Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

DECEMBER 18.—"Basket-Making." By THOMAS OKEY. LEWIS FOREMAN DAY, F.S.A., will preside.

JANUARY 29.—"Artistic Treatment of the Exterior of the Pianoforte." By WILLIAM DALE, F.S.A. T. G. JACKSON, R.A., will preside.

February 19, March 19, April 30, May 28.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

JANUARY 15.—"The Progress of the Uganda Protectorate." By GEORGE WILSON, C.B. Brigadier-General SIR FREDERICK J. D. LUGARD, K.C.M.G., C.B., D.S.O., will preside.

March 5, April 23.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

A. D. HALL, M.A., Director of Lawes Agricultural Trust, "Artificial Fertilisers: their Nature and Functions." Five Lectures.

LECTURE V.—DECEMBER 17.—*Potassic Fertilisers. Consumption of Fertilisers.*

JUVENILE LECTURES.

Wednesday afternoons, January 2 and 9, 1907, at 5 o'clock.

"Perils and Adventures Underground." By BENNETT H. BROUGH.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 17...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. A. D. Hall, "Artificial Fertilisers: their Nature and Functions." (Lecture V.)
University of London, South Kensington, S.W., 8 p.m. Mr. Banister Fletcher, "Greek Theatres and Tombs."
Geographical, University of London, Burlington-gardens, W., 8½ p.m. Col. A. W. S. Wingate, "Nine Years' Survey Work in Northern China and Mongolia."
British Architects, 9, Conduit-street, W., 8 p.m. Mr. W. J. Dibdin, "The Strength and Composition of Mortars."
Actuaries, Staples-inn-hall, Holborn, 5 p.m.
Alpine Club, 23, Savile-row, W., 8.½ p.m.

TUESDAY, DEC. 18...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Thomas Okey, "Basket-Making."
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Henry William Edward Le Fanu, "Mechanical Considerations in the Design of High-Tension Switch-Gear."
Statistical, 9, Adelphi terrace, Strand, W.C., 5 p.m. Mr. William J. Harris and the Rev. Kenneth Lake. "Estimates of the Realisable Wealth of the United Kingdom, based mostly on the Estate Duty Returns."
Pathological, 20, Hanover-square, W., 8½ p.m.
Photographic, 66, Russell-square, W.C., 8 p.m. Mr. Oliver G. Pike, "In Birdland with a Camera."
Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, DEC. 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Albert E. Humphries, "Modern Developments of Flour-Milling."
Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Admiral J. P. Maclear, "The Guildford Storm of August 2nd, 1906." 2. Mr. Richard Inwards, "The Metric System in Meteorology."
Geological, Burlington-house, W., 8 p.m.
Microscopical, 20, Hanover-square, W., 8 p.m.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, DEC. 20...Linnean, Burlington-house, W., 8 p.m. 1. Dr. A. B. Rendle and others, "Botanical Results of the Third Tanganyika Expedition, 1904-5." 2. Mr. F. Chapman, (1) "Fossil Foraminifera of Victoria"; (2) "The Balcombian Deposits of Port Philip."
Chemical, Burlington-house, W., 8½ p.m. 1 Mr. F. R. L. Wilson, "A New Laboratory Method for the Preparation of Hydrogen Sulphide." 2. Mr. V. H. Veley, "The Reaction of Acids with Methyl Orange." 3. Mr. H. Bassett, jun., "Contributions to the Study of the Calcium Phosphates. (i.) The Hydrates of the Calcium Hydrogen Orthophosphates. (ii.) The Action of Ammonia Gas on the Calcium Hydrogen Orthophosphates."
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. H. G. Brown, "The Track Circuit as Installed on Steam Railways."
Historical, Field-court, Gray's-inn, W.C., 5 p.m.
Numismatic, 22, Albemarle-street, W., 6¾ p.m.

FRIDAY, DEC. 14...North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.
Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

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FRIDAY, DECEMBER 21, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 2nd and 9th, at 5 o'clock, by BENNETT H. BROUGH, F.G.S., F.I.C., F.C.S., on "Perils and Adventures Underground."

Each Member is entitled to a ticket admitting two children and an adult. A sufficient number of tickets to fill the room will be issued to Members in the order in which applications are received. Members who desire tickets for the course are requested to apply for them at once.

CANTOR LECTURES.

Mr. A. D. HALL, Director of the Lawes Agricultural Trust, delivered on Monday evening, 17th inst., the fifth and last lecture of his course on "Artificial Fertilisers: their Nature and Functions."

On the motion of the CHAIRMAN, a vote of thanks for his valuable course of lectures was carried unanimously.

The first lecture will be published in the next number of the *Journal*.

APPLIED ART SECTION.

Tuesday evening, December 18; LEWIS FOREMAN DAY, F.S.A., Vice-President of the Society, in the chair. The paper read was "Basket-making," by THOMAS OKEY.

The paper and discussion will be published in a future number of the *Journal*.

CANTOR LECTURES ON IVORY.

Mr. Alfred Maskell's Cantor Lectures on "Ivory, in Commerce and in the Arts," have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures which have been published separately, and are still on sale, can be obtained on application.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready and can be obtained by members on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, December 4th; the RIGHT HON. VISCOUNT MILNER, G.C.B., G.C.M.G., in the chair.

The CHAIRMAN said he had very great pleasure in calling upon Sir Lewis Michell to read his paper on "The Cape to Cairo Railway." Having regard to the composition of the meeting, he thought that the author required no introduction. There was probably no man better qualified to deal with the subject on which Sir Lewis was about to address the audience. He had not only an almost lifelong acquaintance with Africa, but he was also the intimate friend of that great man by whom the idea of the Cape to Cairo Railway was originated, and he was probably as intimately acquainted as anyone now living with the work and the aspirations of Mr. Rhodes. The author, therefore, came before them with very special qualifications. He also desired to be permitted to add, what was known to many, but perhaps not all present, although it would soon be discovered by them, that Sir Lewis was the master of a literary style which was calculated to give attraction and charm to subjects even less attractive in themselves than that about which he was going to speak.

The paper read was—

CAPE TO CAIRO RAILWAY.

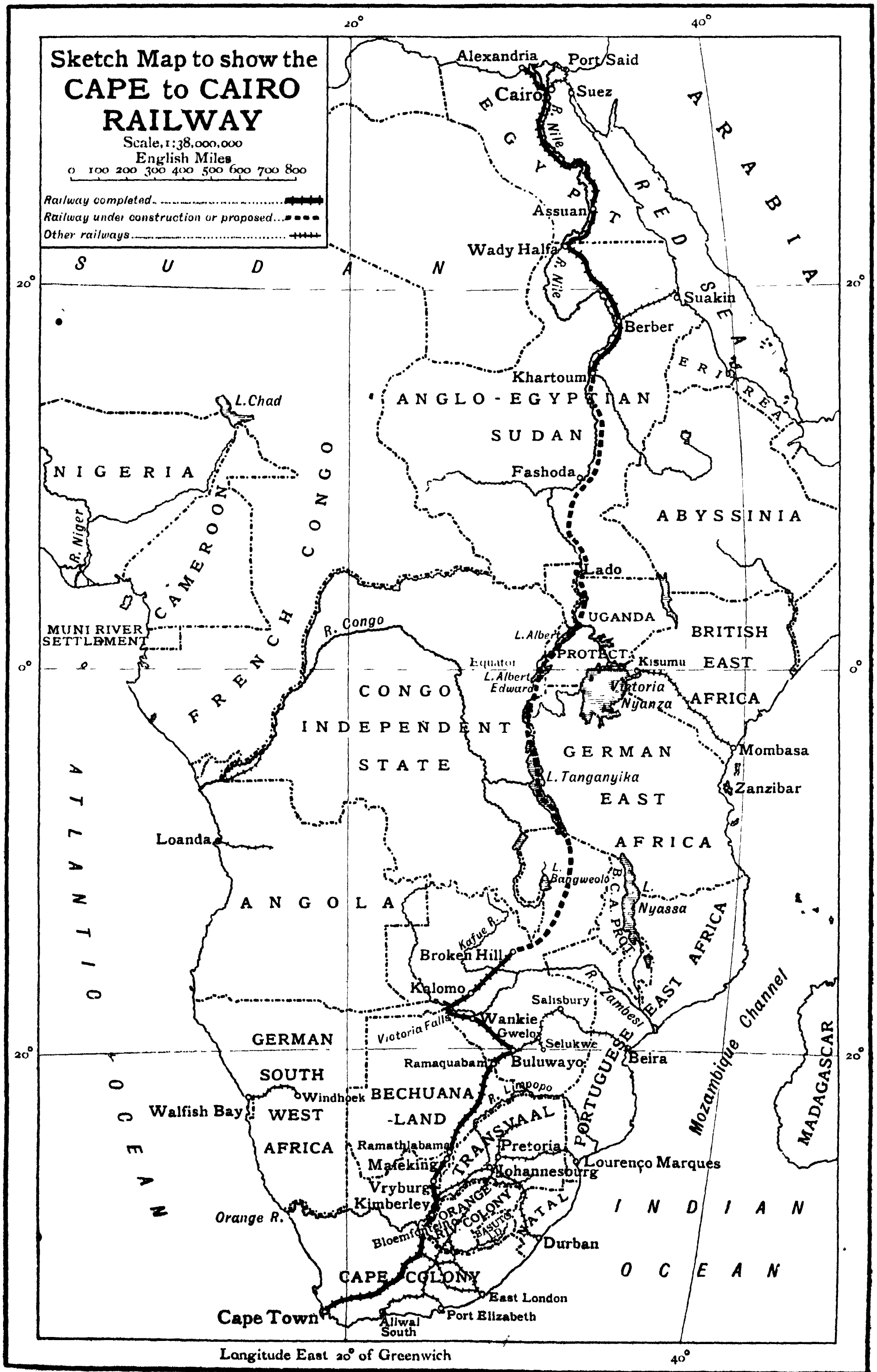
By the Hon. Sir Lewis Michell.

You have been good enough to invite me to read a paper on the subject of the Cape to Cairo Railway as projected by the late Mr. Rhodes. I understand that his friend and ours, Sir Charles Metcalfe, was at one time to have addressed you on the same subject, but was prevented by illness, a fact I deplore for its own sake and also because it transfers the task to one so obviously inferior as myself. I cannot, of course, deal with it from an engineering point of view as Sir Charles is so well qualified to do, but while steering clear of figures and statistics, interesting in themselves but too professional for my powers, I venture to lay before you to-night a few general considerations which seem to me to elucidate the aims and objects of the great scheme.

It is, I know, assumed in some quarters that the idea of such a railway is what the Book of Common Prayer calls "a vain thing, fondly invented," but there is one striking peculiarity about the dreams of the great founder of Rhodesia, that while he dreamt he was generally very wide awake. There are many dreamers in this world whose dreams, however delightful in themselves, come to nothing because they are unpractical; there are also many solid practical business men who leave little mark upon their age because, lacking imagination, they are unable to dream at all. The exceptional man who achieves great things, generally combines the power of dreaming with the practical instincts necessary to enable him to translate his dreams into performances. And of such was Mr. Rhodes. The Cape to Cairo Railway is no unsubstantial dream but a reality, in advance of its age if you like, but still a reality, and already, in great part, an accomplished fact.

As I am not supposed to be dealing this afternoon with that other section of our great pioneering work, the African Transcontinental Telegraph Company, I will content myself with saying here that, after several initial difficulties, the wires have been erected for no less than 1,584 miles. Leaving the Mashonaland Railway at Umtali, it follows the eastern boundary of South Rhodesia, traverses Portuguese East Africa, crossing the Zambesi low down at Tete, serving the well-known missionary station of the Scotch Church at Blantyre, and running through the coffee-growing districts of the Shiré Highlands to Fort Johnston—so named after Sir Harry Johnston—and then onward though the entire length of the British Central Africa Protectorate, touching at many rising villages on the shores of Lake Nyasa as far as Karonga, then westward to Fife and Abercorn, the latter the most northerly point in North-East Rhodesia, and called, of course, after the present Duke, a member, I believe, of this Society, and a loyal and steady supporter of Mr. Rhodes and all his great plans for the civilisation of a continent. From Abercorn the line enters foreign territory, and winding in and out close alongside the eastern shore of Lake Tanganyika, terminates at Ujiji, that historic spot where Stanley found the long-lost Livingstone—a spot which, I say it with regret, though ours by right of discovery, is no longer within our own sphere of influence. Further than this the wire cannot go, except on onerous terms and by permission of Germany; but even in its unfinished state it serves many public and private interests, assists in the preservation of law and order, and is of great and growing commercial value.

It is not so many years ago in point of time that Livingstone and Möhr, Speke and Grant, Baines and, above all, Stanley, roused public interest in the problems and populations of Central Africa. Their journeys were mainly east and west. But what Mr. Kipling well calls the immense and brooding spirit of Mr. Rhodes saw, as in a vision, that civilisation and the trade that follows in its train, might with perhaps greater advantage be introduced into the heart of the Dark Continent from south to north. And instead of resting content with the transient passage of the adventurous explorer and mighty hunter who traversed the pathless forests and unfrequented solitudes of Africa, hatchet and rifle in hand, but left no permanent trace of their footsteps behind them, Mr. Rhodes conceived the nobler but the more practical dream of penetrating the ancient and mysterious continent once and for ever, by laying down from the shores of Table Bay to the blue waters of the Mediterranean, that twin steel rail which has done for the modern world what the great Roman roads did for Europe nearly 2,000 years ago. At what date the idea first occurred to him may, perhaps, never be known, for he was a silent man, not addicted to correspondence, and accustomed to much deep thinking before taking decisive action. But


Sketch Map to show the
CAPE to CAIRO
RAILWAY
Scale, 1:38,000,000
English Miles
0 100 200 300 400 500 600 700 800
Railway completed
Railway under construction or proposed
Other railways
Alexandria
Port Said
Cairo
Suez
EGYPT
R. Nile
ARABIA
RED SEA
Assuan
Wady Halfa
SUDAN
Suakin
Berber
Khartoum
ANGLO-EGYPTIAN SUDAN
ERITREA
L. Chad
NIGERIA
R. Niger
CAMEROON
FRENCH CONGO
Fashoda
ABYSSINIA
Lado
UGANDA PROTECT.
BRITISH EAST AFRICA
MUNI RIVER SETTLEMENT
R. Congo
L. Albert
Equator
L. Albert Edward
Kisumu
Victoria Nyanza
CONGO INDEPENDENT STATE
GERMAN EAST AFRICA
Mombasa
Zanzibar
L. Tanganyika
ATLANTIC OCEAN
Loanda
L. Bangweolo
B.C.A. PROT.
L. Nyassa
ANGOLA
Kafue R.
Broken Hill
PORTUGUESE EAST AFRICA
Kalomo
Salisbury
R. Zambesi
Mozambique Channel
Victoria Falls
Wankie
Gwelo
Selukwe
GERMAN SOUTH WEST AFRICA
Ramaquabane
Buluwayo
Beira
MADAGASCAR
Windhoek
BECHUANA-LAND
R. Limpopo
Walfish Bay
TRANSVAAL
Ramathlabama
Pretoria
Mafeking
Johannesburg
Lourenço Marques
Vryburg
Kimberley
ORANGE RIV. COLONY
BASUTO-LD
NATAL
INDIAN OCEAN
Orange R.
Bloemfontein
Durban
CAPE COLONY
East London
Cape Town
Aliwal South
Port Elizabeth
20°
40°
0°
Longitude East 20° of Greenwich
Emery Walker sc.

the following dates are significant and instructive. It was the Conference of Berlin, early in 1885, which drew public attention to Central Africa, by stipulating for freedom of trade and the suppression of the slave traffic in the basin of the Congo. In the same year the Cape Government Railways, thanks to Mr. Rhodes's persistence, reached Kimberley. In the summer of 1888 he suggested, through a now extinct company—the Exploring Company—a prolongation of the line to the then remote and inglorious village of Mafeking. In the same year he persuaded the home Government, after persistent pressure, to declare Matabeleland and Mashonaland a sphere of influence. Great Britain, then as now always unready, was only just in time. Prince Bismarck and President Kruger were neither of them asleep, and but for the masterful energy and driving power of Mr. Rhodes, the entire territory now known as Southern Rhodesia would have passed into foreign and unfriendly hands, and our access to the vast interior would have been barred for ever. In the following year, 1889, Mr. Rhodes having acquired by concession, purchase, or otherwise all the land and mineral rights between the Limpopo and the Zambesi, absorbed the Exploring Company and other similar expeditionary and prospecting ventures, and at once applied for a Royal Charter to enable him, under the authority and control of the Crown, to administer the new and vast dominion thus acquired. In this way a new province of illimitable possibilities was added to the British empire. The charter bears date October 29, 1889, and, as illustrating the impetuosity with which he prosecuted his now fully-developed railway policy, I may draw attention to the fact that on the very same day Mr. Rhodes signed an agreement with the Cape Government to construct a further section of the line to Vryburg. The Government itself was indisposed to proceed beyond Kimberley, then a rising trade centre. Everything beyond that was regarded as partaking of the nature of rash, if not wild-cat, adventure. They preferred to rest and be thankful. But Mr. Rhodes never rested, and his thankfulness was only for favours to come. His life-work was not to be arrested by the timidity of an unimaginative coast colony. He undertook at his own risk and expense to build the 126 miles to Vryburg and he built them. It was soon seen that the extension was going to be a financial success, and the Cape, by an Act passed in August, 1890, exercised its expropriation rights and took over the line. With the money thus set free Mr. Rhodes, under a second agreement, undertook to construct a further section to Mafeking, and it is characteristic of him that, on this occasion, he left out the expropriation clause, and the section, though on Cape territory, is still the property of the Rhodesian railways.

Pushing still north, under other agreements, he left the old colony at Ramathlabama, traversed the entire Bechuanaland Protectorate to Ramaquabam, and at that point entered Rhodesia, and completed ths line to Buluwayo in October, 1898. The capital of Matabeleland, which is 1,362 miles from Cape Town, would have been reached even earlier but for the intervening events of the Transvaal raid of 1896 and the Matabele rebellion of the same date. During this interval Mr. Rhodes had not been idle. Not only was he engaged in opening up railway communication between Mashonaland and its natural port of Beira, but he had succeeded, after a struggle, in obtaining a supplementary charter, in which was enshrined the great principle for which he always strenuously fought, the principle of preferential treatment for British products and manufactures. At this moment, under this charter, which has the force of law, the Customs duties on foreign goods imported into Rhodesia can be varied and raised at will. Against the foreigner, therefore, who erects a discriminatory tariff wall against us we have the power of retaliation. But Rhodesia cannot under any circumstances increase her duties on goods of British origin. And the working men of Great Britain who benefit by what we call the "Rhodes clause" should remember with interest that he wrung it from a reluctant Government, or, rather, he never gained his point till the advent to power of that great Colonial Secretary, Mr. Chamberlain.

From this date onward Mr. Rhodes strove with feverish activity to push the iron rails further on their way. His natural fervour needed no spur, or he might have been spurred by the knowledge he already possessed that he had not long to live. His speeches delivered about this period to shareholders of the Chartered Company, and at meetings of the Rhodesia and Mashonaland Railways, are full of references to the great scheme. Early in 1898 he addressed the first of several important communications to the Secretary of State for the Colonies, with proposals for an immediate extension of the railway to the southern end of Lake Tanganyika, and in hopes of securing a sub-guarantee of debenture interest from the

Treasury. The correspondence has been published in a White-book, and can be studied by all who are interested in following the working of Mr. Rhodes's mind, or who desire to observe with what courtesy and suavity official departments can turn on the cold-water hose or douche of circumlocution and polite criticism on the projects of men who think in continents. It must suffice to say here that the Treasury was very sympathetic so long as no hard cash was required. But Mr. Rhodes's dreams of empire and its huge responsibilities were too far-reaching for the comprehension of an office like the Treasury, which, not unnaturally, looks more to its British than to its Imperial obligations. Negotiations were practically wrecked on the Treasury demand for a counter guarantee from the Cape Colony, which everybody knew it was impossible to obtain.

The only result of the correspondence was the promise of a moderate subsidy for a limited period. It may be convenient here to refer any one who is anxious for further information on this subject to the great speech delivered at the Cannon-street Hotel by Mr. Rhodes to the shareholders of the British South Africa Company on April 21st, 1898. In that speech he paraphrased the correspondence in a striking manner:—

"What I said to them," he remarked, was "are you not aware that England is nothing without her trade? It is the trade of the world that keeps you going. I have cost you nothing so far. I do not ask you for anything, but you have exceedingly good credit. If we borrow, we pay 5 per cent. I want two millions to get to Tanganyika. Back my promissory note, and I can borrow at 3 per cent. If you are nervous, raise the money for only 100 miles at a time, and let each 100 miles pay before you go further. You thus get the railway to Lake Tanganyika, and then you have Kitchener coming down from Khartum."

I must here admit that this picturesque phraseology does not appear in the official White-book. It is a free rendering, no doubt, but conveys the substance, if not the literal text, of Mr. Rhodes's communications.

Another of his speeches, which elicited widespread and appreciative comment at the time was addressed to the shareholders of the Bechuanaland Railway Company, on May 6th, in the same year, 1898.

It had, I think, a great effect in convincing the public that the Cape to Cairo Railway was not only a national obligation, but would materially benefit British trade. Mr. Bryce remarked that the main value of Rhodesia must be sought in the region of high politics. *The Outlook* declared that the occupation of Rhodesia would secure our ultimate predominance in South Africa. The *Saturday Review* pointed out that Mr. Rhodes had grasped the fundamental fact that our island was nothing if not a great workshop, and that the opening of fresh markets was of supreme importance. The *Morning Post* held that a mid-African railway would extinguish the slave trade for ever.

By other journals it was pointed out that Mr. Rhodes had at one time secured the promise from the King of the Belgians of a strip of land on the frontiers of the Congo State, but that this "way leave" had been withdrawn, owing to the diplomatic representations of France and Germany. It is unfortunately true that by the Anglo-German agreement of July, 1890, a wedge of German territory was allowed to be driven between the Nyanza lakes and Tanganyika, just as by another agreement, equally unwise, the same foreign power was granted access to the Zambezi from the westward by means of an extraordinarily shaped wedge thrust forward into our sphere of influence. A Cape to Cairo line all British was thus rendered impossible by the shortsightedness of Ministers on this side, and Mr. Rhodes, bowing to accomplished facts, had to negotiate with Belgium, or, as an alternative, with Berlin. His desire at that date was to extend the rails from Bulawayo to Gwelo, and thence northward over the Zambesi far to the eastward of the Falls, past Lake Bangweolo to the southern corner of Tanganyika. Traversing the lake by a service of steamers, the line would have crossed the strip of foreign territory he hoped to secure, and, entering Uganda at a point between the Victoria Nyanza and Lake Albert Edward, and still proceeding northward, a little to the east of Albert Nyanza, would have linked up Lado and Fashoda with Khartum, and thereafter with Berber and Wady Halfa, and so on skirting the Nile to Cairo. The approximate distance was 6,000 miles, of which 1,800 would have been by waterway. I was an amazingly bold conception, but too Imperial for those home-bred politicians who only England know. Only genius can understand genius. Mr. Rhodes in a public office was like the proverbial bull in a china shop, and his project, regarded as revolutionary and, indeed, explosive, was, doubtless, labelled "dangerous," securely fastened up with red tape, and deposited—this side up with care—in that pigeon-hole in the archives where it still

reposes. His visits to the Kaiser and King Leopold were unavailing to undo the mischief, though his interview with the former was amusingly characteristic of both parties, and would be found interesting in its details were I indiscreet enough to reveal them to you.

Foiled in his efforts to strike due North, Mr. Rhodes entered into contracts to extend the line in a north-westerly direction, through the teak forests, and on to the great Wankie Coal Colliery, a point reached only after his death. From there it was carried to the Zambesi in 1904, the bridge over which being officially declared open by Professor (now Sir George) Darwin, in September, 1905, in presence of the members of the British Association. Even while the bridge was under construction material was pushed across and the line proceeded with. Kalomo, which is 1,733 miles from Cape Town, was reached in May, Mr. Rhodes's flame of fire having communicated itself to his true friend, the late Mr. Alfred Beit, only lately taken from among us. Beyond Kalomo came some heavy work, notably the erection of a bridge over the Kafue river, the longest, as the Victoria Falls bridge was the highest, in Africa. Under the personal superintendence of Sir Charles Metcalfe, the work never slackened, and in June of this year the first engine ran into Broken Hill. Negotiations are now in progress for the construction of another section to a mine called Bwana M'Kubwa, and it is an open secret that a further extension to Kansanshi is under consideration, which would bring the line to the extreme north-west border of the Chartered Company's territories. The greatest credit is due to those who, through evil report and good report, have financed the railways, to Messrs. Sir Douglas Fox and partners, their consulting engineers, to Sir Charles Metcalfe for his untiring personal services, to Messrs. Pauling, the sole contractors, to Mr. G. A. Hobson, who superintended the building of the great bridge, and to many other brave hearts and willing hands.

To all of us the grief is keen and real, that the familiar face of the founder is missing, but he, being dead, yet speaketh, and his works do follow him. What will happen when our boundaries are at length reached it would be premature to conjecture. A large and highly mineralised area—that of Katanga—is reported to exist in the neighbourhood, but as this is a sober relation of known facts, read before a learned society, and does not partake in any way of the nature of a prospectus, I refrain from indulging in those glowing predictions which might be appropriate and customary were I inviting you to subscribe to an issue of additional capital. But that the Cape to Cairo Railway will be abandoned I refuse to believe. There may be delay, but no prolonged or permanent abandonment of the project. The age is not so prosaic as some people imagine. Romance still exists, and men are still swayed by master minds and great ideas. There are still influential circles in which, as occasions arise, the question is sympathetically put, "What would Mr. Rhodes have done?" The continuity of his policy is thus assured. Whether or not the whole line is completed in our time, the glory of its inception and of its partial construction must in justice remain with Mr. Rhodes. Helped he undoubtedly was by able and loyal co-workers, but without his imagination and insight, without his shrewd business instincts, without his dominating personality, very little progress would have been made. Already the direct and indirect advantages accruing from the line are incalculable. It is sometimes scornfully asked whether the traffic between Cape Town and Cairo will suffice to pay the cost of grease for the axles of the wagons, and whether any sane man who makes the through journey once will ever desire to make it again. These cheap pleasantries do not ruffle our feathers. Mr. Rhodes was no fool and he never anticipated that the through traffic would pay debenture interest on construction; what he rightly relied on was the immense stimulus that the line would give to internal development, to cultivation of the soil, exploitation of minerals, greater facilities for occupation of land, and consequently a steady growth of the white population. That he was justified in his forecast I think no one will deny, though the progress made in these directions may be less rapid than an old man in a hurry, like myself, might desire.

Prince Adolphus Frederick, lecturing last month before the German Colonial Society at Berlin, referred with admiration to the improvement visible in British trade on and around the Victoria Nyanza, which he attributed to the construction of the Uganda Railway. He stated that when he first visited the district four years earlier there was practically no white settlers. Now they were pouring in, and fresh applications for land were being daily received. Traffic on the lake, in consequence of the railway service, had largely developed, and new steamers were being built in

England to cope with it. In conclusion he held up our example as a model to his own German countrymen, an unusual and quite refreshing tribute which I could not refrain from quoting to you.

Always remember, that the British possessions in South Central and Central Africa embrace the bulk of the great plateau of the continent, a plateau averaging more than 4,000 feet above sea level, and hence suitable for occupation by Europeans, provided they are afforded the necessary railway communication to and from the coast. Take the case of Rhodesia alone. Vryburg, where our line begins, is at an elevation of 3,890 feet; Bulawayo, the principal town of Matabeleland, is 4,469 feet; Salisbury, the capital of Southern Rhodesia, 4,825 feet; while the Melsetter and Inyanga districts, from which an export of merino wool has already commenced, stand at between 6,000 and 6,500 feet.

Over the Zambesi, in North-Western Rhodesia, formerly known as Barotseland, the plateau is still preserved. Kalomo, the chief town, is 4,090 feet above the sea; Broken Hill, the present terminus, is 3,988 feet above the sea. If we turn to North-East Rhodesia, we find the great Tanganyika plateau, much of it 5,000 and 6,000 feet above sea level, while the altitude of Sunzu has been stated by Mr. L. A. Wallace to be 7,393 feet, of Mamitawa, 7,239 feet, while the Nyika plateau rises to 8,500 feet.

This is not a gathering of the Statistical Society, but I have troubled you with these figures because they do bear on the question of railway development and land settlement. The Cape to Cairo line is not a jungle line traversing steaming valleys and malarial swamps. It aims at conforming as far as possible to the route recommended by engineers, and what is it nowadays that engineers cannot do? It aims at following the contour of the African watershed, and I do not hesitate to affirm that, where the railway runs, there for the most part white people can settle, and in increasing numbers will settle. Thanks to medical science generally, thanks probably to the Liverpool Tropical School of Medicine in particular, the origin and treatment and even prevention of malaria are becoming facts easily obtainable. Mr. Rhodes lived to know this, and he relied, therefore, on ultimate closer settlement, and on the growing value of local or inter-station traffic in regard to passengers, merchandise and produce. The native races are childishly fond of travelling by rail. Throughout South Africa, they are a traffic manager's best customers. It is true they do not travel first-class, indeed they only travel third, because there is no fourth, and, by preference, they would travel in open trucks with their bare legs dangling over the side. But they are consistent travellers. They travel on the slightest provocation, or on no provocation at all. I have seen them in troops arrive at a terminus, and cross over at once into a return train, thoroughly enjoying themselves regardless of blazing sun and dusty track, for they do not take their pleasures sadly, as we are accused of doing. Then, of course, cheap, quick, transmission of labour is facilitated by the railways, which are in this and many other ways, a great developing and civilising factor. Some of you here may have witnessed what I have often seen in the old days, natives walking literally hundreds of miles in search of work. Scant of clothing, short of food, ill, weary, and footsore, they were sustained only by that incomparably sunny temper which characterises the aborigines of the Dark Continent. Now they ride by rail and enjoy themselves. I remember seeing amid the early morning mists enshrouding the Barberton hills, a shadowy troop of Shangans, some of them in the last stage of emaciation, gliding like unsubstantial ghosts, towards the close of a long toilsome trek, to seek work at the Sheba mine. And though alien to my subject, may I add that on arrival there, when the strongest were taken on and the physically unfit rejected as useless, the former invariably shared his rations with the weaker brethren. Wolfishly hungry the workers were, but half their mess allowance went to those who, without it, would have died of sheer starvation. No ethical or moral deduction should be drawn from the incident. The untutored savage was not a Christian or even a philanthropist. He was acting on strict business principles in order that the invalids might the sooner become wage-earning units, and thus add to the wealth of the whole group.

In other parts of South Africa I have seen natives on trek to or from their labour area so utterly worn out by excessive fatigue that to all appearance their wanderings in this world were well nigh over for ever. Much of this will be mitigated or avoided by the Cape to Cairo Railway and its subsidiary feeders. Labour will now have fair play. The mineral and agricultural development of Rhodesia and districts further south will be immensely facilitated by the great trunk line, and its use will

save the native from untold distress. More distant areas will be tapped, new industries will arise, new wants be created, and the whole of Africa will eventually benefit from the extension of the line. A great army of sightseers, missionaries, scientific investigators, sportsmen, boundary commissioners, police, and civil officials, will also reap the advantage of quicker communication with the interior.

But it is, of course, on goods and produce that the line has mainly to rely, and the Chartered Company is now devoting its energies to the task of attracting white settlers, by whose co-operation trade and agriculture, as they develop, will gradually place the railways on a payable basis.

Need I add here that among the many services rendered by the railway it has rendered accessible to the world, or to that portion of it which travels, the grand waterway of the Zambesi and its mighty Falls, across which it runs on a mighty bridge of a single span, designed by one British firm and built by another. and its construction supervised by a British engineer—a structure so noble in its proportions, so delicate in its tracery, that it will remain an imperishable tribute to the skill of our modern bridge builders.

Here, too, the railway scores another triumph, for it is rendering practicable that great conception of utilising the water-power of the Zambesi to generate electric energy on economic lines over a distance double that attained in America: so that one of the assured events of the near future is that the eternal thunder of the great Falls at one end of the wire will ere long be matched, at its other end, by the roar and crash of the many thousand head of stamps employed by night and day in the largest mining centre in the world.

For my part I foresee the time when our achievement in bridging the Zambesi will appear but an incident in this great undertaking. We are already out of the hearing of the roar of the Victoria Falls; already beyond the furthest point which owned the Matabele sway. We are already in the heart of Barotseland, and practically nobody, in this age of progress, can say to us "Thus far shalt thou go, and no farther." We are investigating the economic value of our teak forests for wood-paving the streets of Colonial towns; we are hoping to exploit the waters of the Zambesi for carrying electrical power to Johannesburg; we are sending down gold and diamonds for use and ornament; we are working our railways with our own coal; we are beginning to ship zinc and lead ore from Broken Hill, and ferrochrome ore from Selukwe to harden steel plates for the British Navy, and, finally, we shall ship copper for your telephone wires, and rubber for your motor-cars. All this actual and potential traffic is due to the waking dream of one great man. Here, at the heart of the Empire, no statue has arisen to the arch-Imperialist, but travel in South Africa and you will feel his spell; you will look around you and see his monument; a monument more durable than brass, for it is the monument of high achievement, and of duty nobly done.

We shall soon, from the observation-car of a railway carriage, look out upon the Congo State. Are we to stop there? It is unthinkable! Mr. Rhodes would not have stopped there. After his manner I seem to dream. I see, as in a vision, a thread-like, serpentine double rail athwart the entire continent. South to North I see the coloured races being conveyed to and from labour centres in health and comfort. I see our crowded and over-crowded areas here pouring out thousands of white men, to build, as Mr. Rhodes wished, "more homes" under brighter skies and happier conditions. I see additional employment here for our own people in manufacturing articles for those who have transferred their domicile to Rhodesia and Central Africa. I seem to see long streams of wagons made in Birmingham and Lancaster, drawn by powerful engines made at Leeds and Glasgow, travelling from the Cape of Good Hope or Beira, ever northward, over rails made in South Wales, and conveying mining machinery, agricultural implements, and articles of necessity, and eventually of luxury, from every manufacturing town of Great Britain. And I see those same wagons coming south, laden with coal, copper, and many other minerals, with timber, wool, and hides and skins, with ivory, tobacco, cotton, rubber, ground-nuts, valuable fibres, and other products of a sub-tropical country. I see the silver tie of sentiment which now binds Britain to her African colonies, strengthened by the even stronger band of mutual trade interests. I see the slave trade finally and for ever eliminated from those remote corners, so full of cruelty where it still flourishes. I see Christianity and civilisation advancing northward hand in hand, to found in Africa another of the vast empires of the world and of the dim future, whose originating centre will be these islands of ours, at once so small and yet so great. And, as I dream, I seem again

to see the wonderful man who now sleeps his last sleep amid the granite kopjes of his own Matoppo Hills. He is at length at rest, but his face is looking northward; and we do well to remember him who, in his all too short life, gave to us, amid many high and fruitful ideas, the wonderful conception of a railway from the Cape to Cairo.

On one point the progress of the railway is watched in certain quarters with feelings of apprehension, and I will not deny that the apprehension is justifiable. We are, as we go north, approaching that central tract of Africa which is being devasted and depopulated by that terrible scourge, the sleeping sickness. The danger feared is that easier, quicker, and more continuous intercommunication may tend to spread the disease to other centres. I can only say that we are alive to the risk, and if, as the Royal Society pointed out last week, the British South Africa Company, with all the immense financial responsibilities resting on it, has recently spent £36,000 in helping science to determine an arc of the meridian, we shall not grudge time, nor trouble, nor expense to protect the white and native populations of the territories within our jurisdiction from the horrors of the sleeping sickness. I have myself within the last few days had an interview with Dr. Todd, than whom there is no higher authority, and he has pointed out the nature of the precautionary steps to be taken to discover and isolate cases and prevent any extension of the area which the disease afflicted. For my part, I venture to think that, with intelligent care, the railway may help and not hinder the devoted medical men engaged in fighting the sleeping sickness, sometimes, as in the case of Dr. Tulloch, at the risk of their own lives.

Before bringing this paper to a close, let me remind you that, while our progress to the North has been fairly rapid and reflects credit on the financiers, engineers, and contractors, it is not the only progress that has been made. I have already quoted Mr. Rhodes's strikingly picturesque dream of "Kitchener coming down from Khartum." Lord Kitchener has long since left Egypt, and served his country well in another part of Africa, but his spirit still haunts the land of the Pharaohs—the strong will still seems to dominate the Sudan. There, too, the railway progress has been considerable. From Cairo or Alexandria southward to Assuan, a distance of 590 miles, the line is constructed, and another 560 miles between Wady Halfa and Khartum, while a further extension of 410 miles to Usambara is, I believe, projected. In the aggregate, the line from the north, completed or contemplated, is thus about 1,600 miles and from the south rather more than 2,000 miles. Add to this the long Tanganyika waterway and you will see that the great enterprise is already far advanced. I do not believe that the courage and tenacity of our race are failing us, and some of those here present here to-night may live to see the land of the Pyramids and the Sphinx linked up with that cape of storms now called the Cape of Good Hope, round which that intrepid Portuguese sailor, Vasco da Gama, drove his crazy barque a little over 400 years ago. I have finished. I trust I have not wearied you. It has been my aim to avoid the dry bones of tabular statistics, but to give you, in very general terms, an outline of the origination and partial completion of a line destined, in my opinion and, I trust, in yours, to regenerate a continent, to bring peace and prosperity to Africa, and an expansion of trade to the country whose citizens we are and whose faithful servants we are proud to be.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said he felt sure that, after listening to the paper, the audience would feel that any promises he had held out in his introductory remarks had been more than amply fulfilled. As owing to the fact that he had to keep another engagement, he would not be able to be present when the vote of thanks was passed to the author which he so amply deserved, and which would no doubt be cordially accorded, he would like to express to Sir Lewis his personal thanks for the delightful manner in which he had brought forward the subject. There were only two ideas which occurred to him while Sir Lewis was speaking which he desired to be allowed briefly to mention. The first was the impression which was made upon his mind as the author went over the stages of the familiar story of Mr. Rhodes's great achievement—the impression of the last, and perhaps most memorable instance in which the power of this country had been extended and its prosperity enlarged by the efforts of individual Britons, in the teeth of the indifference, almost the hostility, of British Governments, and sometimes, it might almost be said, of the British people. That was a familiar story, and it was one which gave ground for hope, even at times when, for other reasons, the prospects of Imperial expansion in our existing dominions might seem somewhat clouded. There was always the ultimate reliance upon the courage, initiative, and patriotism of the individual Briton.

The other point which struck him was the lesson which the story afforded of the stages through which all those great enterprises, like the Cape to Cairo Railway, seemed necessarily to pass. First, there was the brilliant stage, in which the imagination of some great man was fired with an immense scheme of this kind, and in which, by his eloquence and his contagious genius, he carried his fellow men along with him, and obtained the material means which were necessary for its realisation. In that stage there was all the splendour and brilliancy of hope, and there was a glorious vista of a great unknown future. Then came the stage in which the work was realised, or partly realised, and the immediate consequence was that the results, in the first instance, were vastly below what people, at the inception of the enterprise, rather unreasonably expected. Then came the day of the critics, the depreciators, the minimisers, and the people who were always only too happy when they could point out the failure, or what they conceived to be the failure, of any great scheme. That lasted for a time, but it had to be passed through, because a great trunk line of any kind had to create, as it were, its own market, and, indeed, its own world. All the civilisation which it was intended to serve necessarily came after it; it was the basis on which the whole fabric was built, and as long as the base alone was there people said, "Where is this splendid building which we were promised?" He was old enough to remember the time when people used to speak in contemptuous terms of the failure of that great enterprise, the Canadian Pacific Railway. He thought those people had been wise enough to forget their criticisms to-day. But there was a third stage ahead of it, a stage which the Canadian Pacific Railway had already reached, the stage in which all that the line was intended to render possible had come about; and then, though often in forms different from what was originally supposed, the great idea of the original planner found its full justification. They would live to see that stage in the case of the Cape to Cairo Railway, as they had seen it in the case of the Canadian Pacific Railway, and he thought they would see the full material justification of that great enterprise a long time before the whole work was completed. It was possible (though he hoped it might not be the case) that there would be some delay, even considerable delay, in joining up the two ends of the line. But long before those two ends were joined, the existing portions (and he was speaking now more especially of the South African portion, which was more particularly connected with the conception and the work of Mr. Rhodes)—would have fully justified all the great efforts which had been made to create them. It was the chief object of a line like that, not so much to connect its one extreme end with the other, as to connect those otherwise isolated points along the great backbone of the Continent, from which lateral lines ran to the coast, by which trade was developed. It was undoubtedly, in the first instance, the lateral lines which were of importance for trade. He desired the audience, however, to look at the difference between the position of having a number of points right up the centre of Africa, connected with the coast by lateral lines and entirely isolated from one another, and the position which the trunk line created of uniting all those isolated points with one another, and creating internal roads of communication which alone could bind those isolated stations together. It was a matter of enormous importance anywhere, but its importance was all the greater in a country situated as Africa, and especially South Africa, was, in which the points of greatest importance were isolated points on the central high plateau, separated from one another by great distances. They might each have their separate communication with the sea, but the trunk line linked them together, and in that way alone could the scattered centres of civilisation in the heart of Africa be united into one country, and effectively brought within the influence of the British Empire. He wished to express his conviction, that although they might at the present moment still be passing through the second of the stages which he had described, they would enter the third stage before long, the stage in which the immense expenditure, not only of money and of work, but of thought, courage, and devotion, which had gone to carry that great line of communication from Cape Town to very nearly the centre of Africa, would begin to meet with great material rewards. Needless to say they would all rejoice to see them for many reasons—for the benefits which South Africa would derive, and for the advantages to be gained by the trade and the industry of this country; but some would rejoice for another and more personal reason, namely, because those who recognised from the first the greatness of the conception, and who realised from personal knowledge the greatness of the man in whose brain it originated, would be glad and proud to see an achievement which would compel the admiration which they themselves had always felt even from the most critical and the most unwilling.

Sir DOUGLAS FOX, M.Inst.C.E., remarked that, in the absence of Sir Charles Metcalfe, who was on his way home from a second visit to rail-head beyond Broken Hill, he desired to thank the author of the paper for the very kind way in which he had spoken of their firm and of the contractors. His mind was carried back to fifty years ago, when he helped his father, Sir Charles Fox, in connection with the first railway in South Africa—from Cape Town to Wellington and Wynberg. There was a long jump from that time to the day when their late lamented chief, the Hon. Cecil Rhodes, communicated with his firm, and asked Sir Charles Metcalfe and himself to lay down the engineering details which had since formed the foundation for the work which had been described by the author. The system had had one great advantage in the fact that Sir Charles Metcalfe from the first had had the location of the railway, and, therefore,

the whole of it had been laid out with a definite object and in a definite way, and by his own personal observation. He had been largely assisted by those connected with the firm of contractors. He did not think they could speak too highly of the way in which the work had been carried out by Messrs. Pauling and Co. They had enjoyed special advantages from their intimate knowledge of the country, from their most judicious treatment of the natives, which had enabled them to get labour when nobody else could get it, and by their courage in dealing with great difficulties connected with transport, the supply of water, and other necessities which engineers fully realised. A great deal of the rapid progress had been due to the continuous work of the contractors right from the beginning, and he, therefore, felt bound to bear tribute to the excellent way in which they had carried out their duties. His firm particularly thanked the author for the kind way in which he had spoken of them. He desired especially to thank Sir Lewis for the mention he had made of his (Sir Douglas's) partner, Mr. Hobson, to whom so much credit was due in connection with the Victoria and the Kafue bridges, the whole of the details of which came under his especial care. They were still with their faces firmly set northward. They had passed over great difficulties, and he did not think they had any greater obstacles in front of them than they had already surmounted. He believed they would have just the same earnest support from the contractors as they had always received, which had been such a great factor in the success of the undertaking, and he believed that before long the railway would reach the utmost limits of the British possessions. The more that was seen of the opening up of the country, the more practical men felt convinced that, in the Rhodesia railways, there was a noble and glorious future, not only for the shareholders but for the British Empire.

Major E. H. M. Leggett, R.E., D.S.O., said that as one who had been very humbly connected with development work in Africa, and who had felt what it was to work under that vast brooding spirit which hung over Africa, he felt it his duty to rise and confess the faith that was in him. The spirit which was left behind by Mr. Rhodes was no small thing, and its material symbol was the Cape to Cairo Railway. But, great as was its material value, this great work of genius conceived by a mighty brain and forged by brave men, had had a remarkable effect upon the character of all who were brought in touch with it, and influenced many in the performance of their small daily avocations. It was only practically a few years since this great conception arose in the brain of Mr. Rhodes, but demands for railways were now being received from Nigeria, Uganda, British Central Afriea, and other possessions. The Uganda Railway, which, curiously enough, was not in Uganda at all, was built almost by accident, certainly without anyone realising the enormous value it would prove to be in the development of the colony; and the position in Nigeria and British East and Central Africa was exactly the same. The men who were developing those countries were inspired by the conception of Mr. Rhodes, and by the forcefulness with which he made that conception a living fact. With regard to the future of tropical Africa, it possessed rich soil, fine uplands in which white people could make their homes, and a climate which, though tropical, was suited to white planters. On the lower levels the soil could produce two crops a year over large areas, and the staples were cotton, indiarubber, fibre, and other necessities of the world's commerce. Those were the industries which the African Empire held out to them as the reward of enterprise, the conception of which originated in the Cape to Cairo scheme. He claimed that the colonial work of the twentieth century was the development of the Central African provinces. Sir Lewis Michell had said he had great faith in the British public; but it must be remembered that when Mr. Rhodes, less than ten years ago, asked the Imperial Parliament to help him, instead of doing so they debated the question of whether trams should run over Battersea-bridge. He hoped that a paper such as they had just heard could be read annually, so that the importance of the scheme might be kept before the eyes of the public and the memory of the great man who conceived it might not be forgotten.

Sir Charles B. Elliott, K.C.M.G. said that as he held a kind of brief for the Cape Government in connection with his appointment as Honorary Special Railway Commissioner, he thought it was his duty to comply with the request made to him to join in the discussion. Sir Lewis had referred to Mr. Rhodes as a dreamer, but Mr. Rhodes once called himself a painter, as he had succeeded in converting a territory which belonged to the natives into British territory, and thus painted that portion of the map red. He (the speaker) was fortunate enough in being asked by Mr. Rhodes to construct the first portion of the line from Kimberley to Vryburg. Mr. Rhodes requested the Government to sanction his appointment for the purpose, the whole arrangement being settled in two or three minutes. Mr. Rhodes gave him *carte blanche* in the construction of the railway, and he went on with the work, not as a Government line, but as a line that would be made by an ordinary contractor. But, in a clause in the contract, the Government had the right to take the railway over as soon as it was constructed, at cost price, and that course was adopted at a cost certified by himself. The benefit to the Cape of the railway had, he believed, already been very real, and he hoped it would increase. Although there were rival ports which considerably interfered with traffic to and from the Cape, yet he felt sure that every facility for traffic must be, more or less, a help to all the ports. It was quite true that certain ports might suffer. He found in his experience that when a terminus of the railway was made in a certain town or village the place prospered, but when the

railway was extended the place lost its prosperity and reverted to its normal condition. That was a condition which many railways had to face. In America the railways were sometimes made, and the towns were then built along the railways. In Africa, to a very large extent, the railways had been constructed, not according to the bee line, but according to the position of the towns or villages which it was expected to serve. That was the reason why a very straight line of railway was not generally seen in Africa, as it was in some parts of America. The author had referred to the large teak forests of Rhodesia, and had suggested that the wood might be utilised for paving the streets in colonial towns. He took a special interest in the subject when he was in Bulawayo, and brought a moderately sized log of teak wood back with him, being very much struck with its beauty. He had seen articles of furniture made with that wood in the club house at Bulawayo, and Mr. Rhodes had a bedroom suite made of similar wood. It had a black vein, which reminded him of a black-veined fish in South Africa well known by the name of "galjoen." If it was polished on an emery wheel revolving at 3,000 or 4,000 feet a minute, it obtained a surface like glass, and made a more polished surface than he had seen given to any wood in any part of the world. Last year he received a sleeper made of Rhodesian teak, which he had cut into various portions and sent to Messrs. Holtzapffel, the well-known lathe makers and turners, but he was disappointed to find it did not turn out like the previous specimens. He thought such wood would be more suitable for handles of tools than anything else. Evidently there were different kinds of teak in Rhodesia. When he was general manager of the Cape Government Railways, he calculated the cost of the transport of the wood from Rhodesia, and he feared it would be too expensive to bring it down to Cape Town. His impression was that it would have to be carried to the eastern coast and then conveyed by steamer, if it was to be utilised for the purpose to which the author had referred.

Upon Lord Milner vacating the chair, his place was taken by the Chairman of the Colonial Section (Sir Westby B. Perceval).

Sir David Gill, K.C.B., F.R.S., said he was sure that all present desired to thank Sir Lewis very sincerely for the warm and weighty words he had used in describing the Cape to Cairo Railway, and for the beautiful account of his dreams of the future progress of the country. For his own part, he could not speak from the point of view of a general manager of a railway, but he had been interested in a parallel scheme, the extension of the Arc of the Meridian through South Africa, and with the assistance of Mr. Rhodes and the British South Africa Company, that work was somewhat ahead of the railway. They were parallel instances of the progress being made in South Africa, and they were advancing the cause of science, of commerce, of civilisation and of progress together. He had the honour of being asked to the opening of the railway at Bulawayo not many years ago, and he should never forget the remark made to him by an old missionary there, who said that the first time he came to Bulawayo it took him eighteen months to get there from Port Elizabeth, travelling as fast as it was possible for him to do, because he had to stop in the dry season in certain places, and wait till the grass grew before his oxen could get on again. That was a simple illustration of the enormous advantages conferred upon the country by the construction of such a railway. He remembered not very long ago tasting the best coffee he ever tasted in his life, and he wished he were in the position of the man in Pears' Soap advertisement, when he said he had since "used no other." The coffee came from Lake Nyassa, and he knew there was a splendid opening for coffee growing in that district if labour could only be found. The author had mentioned one fact in a casual way, the immense importance of which he did not think was realised. Sir Lewis mentioned that chrome iron, which was required for the construction of the hardened plates used for the protection of men-of-war, had been found in Rhodesia. The author did not mention, however, the most important fact that, so far as they knew, until the discovery was made in Rhodesia, Turkey was the only source of supply of that particular chrome iron. It was not very long since England was in serious diplomatic difficulties with Turkey, and had any trouble ensued, this country would have been deprived of the power of building men-of-war protected by hardened iron plates. The Chartered Company had reported that they had mountains of chrome iron, and Rhodesia had already sent three shipments of, he believed, 800 tons for the use of the British Navy. That showed in one way how tremendously important might be, in fact already were, the products of the country, not only to South Africa, but to the Empire, from the creation of the railway. He felt sure that the railway would in the future make sure and steady progress, as it had already done. The spirit of Rhodes still abided in the directors of the British South Africa Company; and with the power they held in their hands, and with, he hoped, the money of every true-hearted British citizen, if necessary, the work would go on until the dream of its great originator was realised.

Commander B. Whitehouse, R.N., said he was not very well acquainted with the part of Africa through which the Cape to Cairo Railway was intended to run. He noticed it had been said that the railway did not appear to be very straight, but that it deviated to the west in the southern part to the Wankie coal fields. In the same way, when it arrived at the north end of Lake Tanganyika it would also probably have to deviate to the right to the Victoria Nyanza, because that was certainly the shortest way to the coast. Looking at the map it

would seem that, at the edge of British East Africa, was the straight line to the Victoria Nyanza, and the shortest way to Tanganyika, was to go up across the Uganda Railway and down by a railway which must eventually be built. The Germans quite saw that a connection must be made, and were likely to make a road. He had just come from the south end of the lake, where he had heard it suggested that motors should be run on that road. If it was proposed to make a road along which motors could travel, it would also be necessary to build permanent bridges, and if all that work had to be done, they might just as well make a rail road at once and be done with it. He had also heard the remark made that the trade along the south part of the railway would not pay for the axle grease. A good many remarks like that had been made about the Uganda Railway, and, therefore, it was very gratifying to know that during the last six months the working of the Uganda Railway had resulted in a profit of £40,000. It had been stated that one wagon a month on the railway would suffice for all the needs of Uganda, but it was now carrying so many loads that it was rather tired and could not carry them all. The consequence was that two steamers, in addition to the two already employed, were being built for use on the lake, and he did not think there was the slightest doubt if the Tanganyika route was opened up that the four steamers would have to be increased to six. There was plenty of water for the steamers nearly all over the lake, and he did not think there was the slightest doubt about the traffic. The original idea of the railway was to touch the nearest point to the coast. That had been carried out, and there were now many loads going across the lake to Tanganyika and the Congo State.

Sir WESTBY PERCEVAL said he was only a *locum tenens* for the Chairman, and in that capacity it was his privilege to ask the audience to cordially thank the author for his paper. But before doing so he desired to tender to Lord Milner the thanks of the Society and the audience for his attendance at the meeting, which had added so much to the interest of the paper. The paper was of great value, and drew attention to a subject about which he was afraid the British public as a whole knew very little. Personally he had no connection with South Africa, but he was a Colonial; and no one recognised more than he did, the value of Colonial expansion to the people of this country. How the people of this country could think that anything would tend to their ultimate benefit so much as the expansion of British possessions beyond the seas he could not imagine. It only remained for him to ask the audience to join with him in according to Sir Lewis Michell an exceedingly hearty vote of thanks for his paper.

The resolution was carried unanimously, and Sir Lewis Michell having expressed his acknowledgements the meeting terminated.

FIFTH ORDINARY MEETING.

Wednesday, December 19th, 1906: THOMAS HUDSON MIDDLETON, M.A., Professor of Agriculture, Cambridge University, in the chair.

The following candidates were proposed for election as members of the Society:—

Baltischwilder, J., Grand Hotel, Zurich, Switzerland.
Chambers, Alexander George, 8, Khersonskaja, Onlitsa, St. Petersburg, Russia.
Hobsbaum, Isaac Berkwood, F.C.S., 79, Claremont-road, Forest-gate, E.
Ijuin, Admiral Goro, I.J.N., The Admiralty, Tokio, Japan.
Kerr, George A., Lynchburg, Virginia, U.S.A.
Newman, Arthur D., Messrs. Fraser and Chalmers, Limited, P.O. Box 619, Johannesburg, Transvaal, South Africa.
Trimmer, Lieut.-Col. Augustus Richard, Parkstone, Beckenham, Kent.
Walker, Captain Herbert Marriott, 228, Mackenzie-road, Beckenham, Kent.
Wyllie, Lieut.-Col. Sir William H. Curzon, K.C.I.E., M.V.O., 10, Onslow-square, S.W.

The following candidates were ballotted for and duly elected members of the Society:—

Brookesmith, Frank, Dalrymple-road, Appleby, Invercargill, New Zealand.
Faulkner, P. Leo, A.S.P., Shillong, Assam, India.
Horsley, Gerald Calcott, F.R.I.B.A., 2, Gray's Inn-square, W.C.
Rouse, Herbert James, c/o. Messrs. Mackinnon, Mackenzie & Co., Ltd., Strand-road, Calcutta, India.
Wood, Thomas Alexander Stephen, Penshurst, Prince of Wales-road, Carshalton, Surrey.

The paper read was—

MODERN DEVELOPMENTS OF FLOUR-MILLING.

By ALBERT E. HUMPHRIES.

Flour-milling involves mechanical separations only — no fundamental change in the constitution of our raw material and its products. We have to remove dirt and extraneous matter from the wheat, and, having done so, to effect as perfect a separation as possible of husk from kernel. In doing so we reduce the kernel to the powder known as flour or wheaten flour.

I want to avoid the unnecessary use of technical terms, and the first evidence tendered of this good intention is the use of the terms husk and kernel. The husk, known

commercially by the generic term of millers' offal, is divided according to size into various commercial grades, sold under various names in different parts of the country, such as bran, pollard, randans, gurgeons, sharps, toppings, shorts, middlings—all representing from the microscopist's point of view a jumble of the various skins of wheats known to him, mixed with a proportion large or small of kernel. For let it be clearly understood that few if any of the separations we make are perfect. Flour contains some amount of husk, offal contains some amount of kernel, the excellence of our milling, according to our own standards, depends upon the degree of perfection attained in our work of freeing the wheat first of all from impurities, and then on the degree of perfection attained in effecting a complete separation of husk from kernel. I shall, for the sake of simplicity throughout the greater part of this paper, speak of our numerous products of cleaned wheat as in essence two only, flour and offal, kernel and husk. Later on I shall briefly refer to another one, germ, but at this present moment there is no necessity to dwell on that.

Change in the Nature of Wheats Available.

For a proper comprehension of my subject, it is necessary to consider the wheats available for the use of British millers in the last thirty years. In the years 1868 to 1872 inclusive about 60 per cent. of the flour consumed in the United Kingdom was made from home-grown wheats. In the last five seasons we have produced at home only 20 per cent. of the wheats consumed. This difference between the respective periods is sufficiently striking for the purposes of my present argument, but it is important to bear in mind the great difference in the sources of our foreign supply. In 1872 we obtained a large proportion of it from Russia, and it is interesting to be reminded that we received in that year substantial quantities of wheat from Germany, France, and Chili. Almost all of those wheats may be described as mellow with relatively tough skins. From Russia we still get large quantities, but they form a smaller proportion of our total foreign supplies than they did in 1872, and from the other countries named we get practically no wheat nowadays. Then we obtained a substantial quantity from the United States and a little from Canada, but from the miller's point of view the character of the wheat, having regard to the way it behaves in the process of milling, has largely changed. The wheat grown in the Eastern States and Lower Canada was not dissimilar in its characteristics to English, and it was from those parts that the wheat exported to us was drawn. But the invention of the self-binding harvester revolutionised wheat-growing, inasmuch as its growth was not so much restricted by the available supply of labour at harvest time, and as a consequence the wheat fields of the United States and Canada were moved westwards in both countries, into the "North-West" and Manitoba respectively. There the farmers grew wheat, which behaved quite differently in the mill to the older sorts. Furthermore, in 1872 we obtained nothing from India or the Argentine Republic, and only a trifling quantity from Australia. Now we obtain huge quantities from these new sources of supply. The bearing of these facts on my subject is this. In milling we are bound to use force in grinding, and the method of applying this force has a most important effect upon the division of husk from kernel, but a factor in the case almost or quite as important as the method of grinding, is the character of the wheat operated upon. If the wheat be mellow, and possesses a tough skin, a method of grinding involving much friction will not pulverise the husk to any great extent, but if the wheat be hard, and possesses a friable skin, such a method of grinding would pulverise a substantial proportion of the husk so that the quality of both the flour and the offal would be lowered. The bread produced from such flour would be exceedingly dark and unpalatable, and the owners of horses and cattle would complain of the offal; many would abstain from buying it.

A gibe aimed at British millers was that we let the Hungarians and Americans get the start of us in the adoption of modern milling, and although we are to-day second to none in the art of milling, and in the skilful application of it to modern requirements, we have to admit that the gibe was based on fact, so that we lost in the early days of roller milling a large amount of trade, but it seems to me that this slowness of ours in adopting modern methods was not due exclusively to our native and national conservatism, but to an application of the axiom that "necessity is the mother of invention." Modern milling had its inception in Hungary. The best varieties of wheat grown in that country are as good as any the world produces, but they are hard, and have friable skins. The necessity for handling

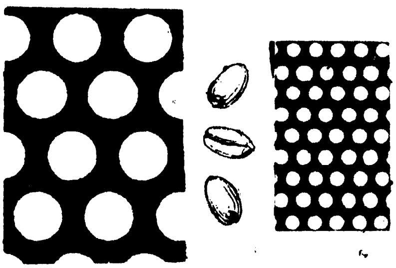
them gently in milling was urgent. No known implement for grinding wheat, not even the millstone at its best, can at one reduction resolve wheat into finished flour and finished offal. That was the aim of millers forty years ago, but it was not achieved. They obtained an intermediate product which was neither flour nor finished offal. If that were again ground on millstones, the finished flour obtained from it was too dark, even for those days, so the miller made as little of this intermediate product as possible, and frequently sold it without further treatment for making coarse biscuits or as pig food. The trouble was accentuated when wheats were hard. The Hungarians discovered that by an application of wind currents, called purification, it was possible to eliminate the particles of light specific gravity, largely offal of an awkward size, from this intermediate product, and that if the purified stock were ground by rolls, flour of first rate quality could be obtained from it. The improvement was so great that instead of making as little as possible of this granular intermediate stock, the object became to make as much as possible. About this time the great wheat lands of Minnesota and the Dakotas were being opened up, and the grain they produced was altogether harder and had a more friable skin than the wheats grown in the Eastern States. The millers in those districts could not make flour by millstones from their wheats, which could compete in the markets of the world with the flour made by millstones from the more mellow wheats, and with American quickness of thought and action they adopted and developed the new ideas of the Hungarian millers. The position of British millers was then exceedingly difficult, for we found to our cost that we were being very badly hurt in at least two ways. One was that the new varieties of hard wheats were, in fact, far better wheats than the mellow ones, and that they were likely to oust the mellow wheats from the importing markets of the world. The other important trouble was, that even though the advantage of the new methods was more striking in the milling of hard wheats than in the milling of the mellow ones, and though it might be possible to prolong the commercial existence of the older mills if mellow wheats were obtainable, the new processes did actually produce better flour than the old ones from mellow wheats. There were in these conditions sufficient reasons for British hesitancy; but ultimately the superiority of modern methods asserted itself, and British millers saved their commercial existence by adopting them. Do not for one moment imagine that we liked the change. It was sheer necessity, not love of novelty, which drove us into spending the huge sums of money now locked up in plant, immensely greater than the amounts necessary for old-time milling. If we could to-day get anybody to buy the flour made from the wheats now available by millstone milling as it was practised forty years ago, we could afford to sell it at less money per sack—not more, as some of our food reformers would have you believe—for our working expenses, including interest on capital and depreciation, would be much less. But bear in mind that the bread made from such flour would not be the same article as that which our fathers ate, but something altogether different. I certainly should not like it, and I do not think the most ardent "food reformers" would. The principal point to be taken from this section of my paper is that the developments of modern milling have been caused largely by revolutionary changes in the origin and nature of our raw material. To illustrate the importance of this point I have brought here two pairs of loaves. To avoid complications, I have for the purpose of the comparison chosen wheats grown in England. One pair of loaves is made from a mixture of average English wheats, the other pair is made from Fife wheat grown for the fifth consecutive year in England. All the wheats were equally clean, but the Fife wheat was much harder than the others. One member of each pair was produced from millstone-made flour, the other from absolutely the same wheat made by roller milling. Even in this artificial light the difference in colour is striking, but to render the comparison more effective, I have, in accordance with a method I have used for a great many years, reduced to marks my opinion of their respective colours. The scale is arbitrary, but quite sufficiently accurate. The flour made by roller milling from average English earned 58 marks, the flour made by roller milling from English-grown Fife earned 80 marks, but whereas the millstone-made average English fell to 35 marks, a difference of 23 marks, the millstone-made Fife fell to 25, a difference of 55.

Wheat Cleaning.

One great development arising out of this change in our raw material was the absolute necessity for more efficient wheat-cleaning.

The English farmer of olden time, when the price of wheat was high, prided himself on the cleanliness of the corn he sold. Almost all the cleaning this wheat received before it was ground was carried out in the barn; the miller oftentimes did not think it necessary to clean it at all, but as prices fell, labour became relatively dear, and machinery was used in harvesting, so even English wheat began to contain some seeds, dirt, and stones. Foreign wheat always was relatively dirty, but with the advent of the new sources of supply we had to deal with an increased proportion of strange admixtures such as barley, oats, pulse, seeds of innumerable varieties, dirt, stones, excrement of vermin, &c. To extract such impurities much ingenuity and expenditure of capital for plant were necessary. Our mills to-day contain more machinery used for the purpose of wheat-cleaning only, than our fathers used in the complete processes of milling. I do not propose to

FIG. 1.

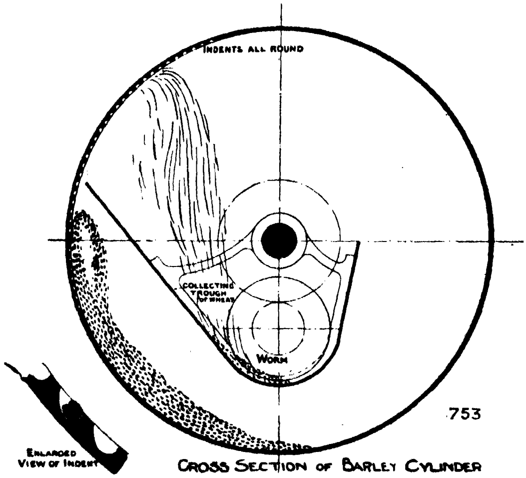


give you detailed descriptions of any of our machines, but to indicate briefly the principles upon which they work. Let it be understood throughout the remainder of this paper that the sizes of the various machines vary in accordance with the amount and character of the work required of them, and that different makers apply the principles involved in different ways.

The cardinal principles employed in wheat-cleaning are separation by size, separation by specific gravity, the use of attrition, and washing. Separation by size is applied in several ways. The simplest form is the use of a vibrating sieve. The separating medium is perforated metal, and the perforations are of various sizes according to the separation desired. For instance, if the impurities to be removed are larger than the wheat, the perforations would be of a size designed to let the wheat pass through them, and to carry away to a proper receptacle beans, peas, lumps of dirt, sticks, stones, &c., of large size; or if, for instance, sand and small-sized impurities are to be removed, the perforations would be small, so that the wheat will pass over them and the small impurities drop through them. Fig. 1 shows some grains of wheat photographed alongside two specimens of perforated metal.

This simple form of separation is used for preliminary treatment of the wheat; it is not sufficiently precise for difficult work. For instance, if small seeds are to be removed, a device far better than the sieve is a hollow cylinder made of zinc. On its inner side

FIG. 2.



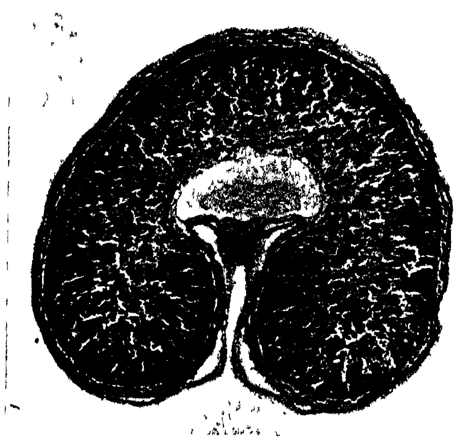
round indentations have been made. These indentations will receive the seeds, but are not large enough to take the wheat. The cylinder revolves slowly and the seeds fall of their own gravity into a channel placed inside the cylinder when in the course of a revolution the seeds in the indentations have been lifted high enough.

To remove such impurities as barley and oats from wheat, cylinders are used, but the application of the principle of separation by size differs from that just referred to. The seeds were smaller than the wheat, so the indentations were small. Oats, barley, and similar impurities are longer in the berry than wheat, so the indentations are made just large enough to receive the wheat, and small enough to exclude the longer berried impurities, and whereas small seeds were taken away from the wheat, in the case in hand, the wheat is taken away from the longer berried impurities. The illustration (Fig. 2) represents the cross section of such a cylinder.

Attrition is applied by passing wheat into a cylinder clothed wholly or in part with a finely perforated cover. Inside this cylinder metal beaters revolve at a great speed, and cause the grains of wheat to be rubbed with violence against themselves and the cover. This process is known technically as scouring.

The principal object is to remove adherent dirt and to break up lumps of dirt, or smut balls. If our fathers forty years ago cleaned wheat at all, the cleaning almost always took the form of separations by the use of sieves and of a form of scouring, both very imperfect methods. Scouring is still largely used as a part of our later methods, but there are two great

FIG 3.

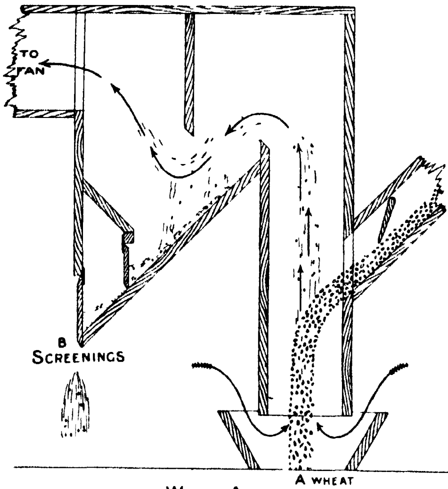


PHOTOMICROGRAPH OF A GRAIN OF WHEAT MADE BY MR. A. D. HALL.

objections to it, one that its object can generally be attained by the use of far less friction, and the other that it can never free wheat from dirt and dust owing to the peculiar shape of the berry. A glance at the illustration (Fig. 3) will show what I mean. The section was stained to bring into view the proteids, so the general dark colouration inside the endosperm cells represents proteid matter, the round dark specks the nuclei, which are very well defined because the section was cut from a partially ripe grain. The square-looking aleurone cells show up particularly well in this illustration.

Barley has no crease, that is to say no recess in its circumference, so it can be cleaned by a scourer such as I have described, but the possession of a crease is fatal to the attainment of that object in the case of wheat. You will notice that the crease of the grain of wheat in the illustration goes almost through the berry to such an extent that about one-third of the husk is situated in it. A large proportion of dust and dirt can lie in the recess so formed, out of the reach of the severest scouring. Having regard to the fact that in the old processes of milling, the crease was never effectually cleaned, it is not difficult for a miller to believe in the proverb which suggested that each person had to eat a peck of dirt in his lifetime. Modern milling has changed that state of affairs, as I will show directly. We retain the use of attrition in two main forms. One is in essence, the same as that practiced

FIG 4.



WHEAT ASPIRATOR 754

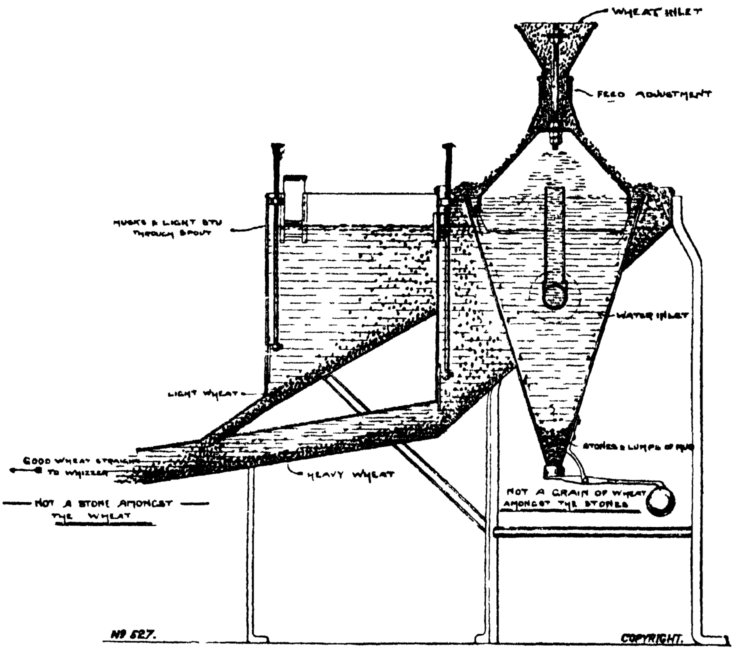
by our fathers, a form which is useful under some conditions. In the other form attrition is applied by the use of brushes, and that is most decidedly useful in the final stages of wheat cleaning, to take away impurities loosened by the earlier processes and by washing, but not completely removed. In some brush machines the wheat is passed between successive pairs of brushes, in others they take the place of metal beaters used in scourers and brush the wheat as it passes through the space between the revolving brushes and the stationary cylinder.

The principle of separation by specific gravity is very old indeed, and the use of wind for the purpose reminds one of the Psalmist. We separate chaff from wheat even now-a-days by wind, and use wind currents to separate other impurities from wheat in which the differences in specific gravity are far less than those between chaff and wheat. For instance,

to get away light shrivelled corn, small or light oats, small or light barley and light seeds, or, to state the point with more precision, to remove any extraneous matter whose specific gravity, as distinct from mere size, is less than wheat, we pass the feed down or through properly constructed passages, up or through which air currents capable of precise regulation are passed. These air currents carry away in them from the wheat the particles or substances of light specific gravity, including dust, and deposit them in separate places provided for them. Fig. 4 shows, in a simple form, the application of the principle.

An upward current of water is provided, the intensity of which can be regulated. On to this ascending current of water, the wheat containing stones is fed in an even stream. The water carries the wheat over with it into a machine called a whizzer, the stones drop through the ascending current of water into a place prepared for their reception. Another reason why water is used for this purpose instead of wind currents, is that the same operation, or substantially the same operation, washes the wheat. The crease to which I have particularly referred gets cleaned, lumps of dirt are dissolved, and the spores of bunt are

FIG. 5.



The strength of the air currents depends on the type, size, and speed of fan used, upon the use of regulating valves and other technical details. Sometimes air currents are used for separating stones from wheat, and in that case, as the specific gravity of stones is greater than that of wheat, the currents have to be just strong enough to carry away the wheat, and leave the stones behind. This method of extracting stones is not now in general use, because it was found that they could be extracted with greater ease and certainty, by the use of water.

WHEAT WASHING.

Such a stoner, of simple construction, is shown in this illustration (Fig. 5).

removed. The greater whiteness of modern flour is to a large extent due to the invention of this washing process. No doubt if it had been invented in millstone days, the flour made by that method of grinding would have been better than it was, but highly important though it is, it is not the only cause for our improved flours as we shall shortly see. The point to be taken at the moment is that stones, pieces of brick and such impurities are extracted through their differences from wheat as to specific gravity. Extremely dirty wheats, such as Indians, which have contained from 2 to 8 per cent. of absolute dirt, require a longer immersion or two washings. The wheat having been stoned and washed is separated

from the water rapidly by centrifugal action, generally by beaters working inside a perforated case, and then passed into drying machines. The wheat is made to pass through them in continuous streams, and currents of hot air and then cold air are blown through it, until it is dried sufficiently. This implies that wheats are not all dried alike, and that is true. Some wheats contain originally too much moisture, and therefore we have to reduce it; others are too dry to yield the best results either in a mill or in the bakehouse, so we intentionally let a few wheats absorb some water. If the miller grinds a mixture of very hard wheats and very soft wheats, the particles of flour produced retain to a large extent and for a considerable time the differences in nature which characterised the wheats from which they were produced, and to secure the best possible results in the bakehouse the particles of flour should be as nearly alike as to size and hardness as possible. The cattle feeder also demands that the offal should be not only good but of good appearance. This equalising of the condition of wheats has become an important part of a miller's education, and upon its efficiency depends to a large extent the perfection of the separation of kernel from husk, the ease or difficulty of making it, and the quality of the goods produced.

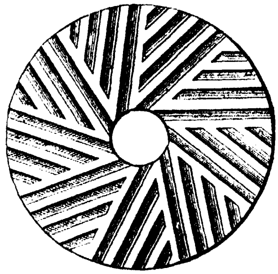
The number of machines used for wheat-cleaning in a mill equipped on modern lines would depend on the class of wheats ordinarily used, and on the quantity of wheat milled, but some idea of the amount of work involved in wheat-cleaning may be gathered from the fact that wheat has to pass through from six to ten separations by size on successive sieves; through from six to ten separations according to specific gravity by wind currents; through, say, two scourings or brushings; and through one, sometimes two, washings and dryings. To extract stray pieces of metal, such as nails and wire, the wheat is passed over magnets, which retain such metallic impurities.

Grinding.

I must not dwell any longer on the important processes of wheat-cleaning, but pass on to the processes of grinding and the separation of husk from kernel. It is obvious that considerable force has to be applied in grinding; but a great underlying principle of modern milling is the reduction of the amount and intensity of the friction used in grinding. To those of you who know the great number of rolls employed in a modern mill, and the number of successive grindings to which the wheat and its component parts are subjected nowadays, and who recollect that thirty years ago it was the aim of millers to effect the complete reduction of wheat in one passage between millstones, this statement of mine as to the diminution of friction may seem paradoxical, and it is necessary for several reasons to establish the truth of my statement.

I am just old enough to have worked in the millstone era, and shall always entertain the millstone miller's affection for that fine implement. It was no upstart, but, on the contrary, the quintessence of the experience and knowledge of very many generations of capable millers. Millstone building was a recognised trade of specialists, and the stone-man was a skilled man of high standing in the mills of those days. For the grinding

Fig. 6.

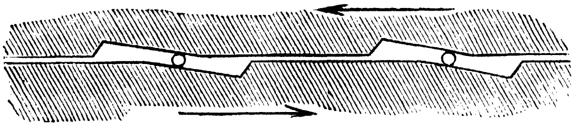


of wheat, millstones made of a special form of stone were used, found in comparatively small layers in various parts of France. It was known as French burr, and was a form of flint, practically pure silica. No great quantity of it existed, but even so there were several subdivisions of it according to quality. The best millstones were built of many pieces of burr, selected for quality in the general sense, and, in particular, for their different characteristics according to their position in the finished implement and the work required of it.

When finished, millstones were circular and worked in pairs, usually in a horizontal position, and provision was made for ensuring not only a standing balance but a running one also. As a rule, the under one was stationary, the upper one, weighing from 10 to 15 cwt., was usually suspended on one central point and revolved at a rate of 120 to 140 revolutions per minute. Their surfaces, more particularly near the circumference, had to be kept in a practically perfect plane, for the relatively ponderous upper stone had to run so near the

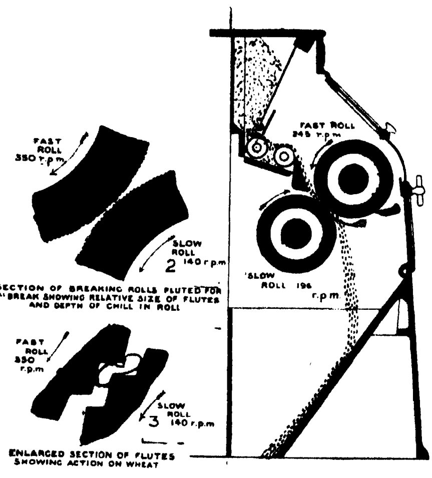
bedstone without touching it at any point that the husk of the wheat, in thickness of almost infinitesimal measurement, had to be touched on both sides by the stones without being unduly pulverised. In Fig. 7, the stones are not shown so closely together as they would be in working. It is obvious that to obtain high-class work the trueing of the face and all the adjustments had to be of the highest class. No one ever discovered the course of the grains of wheat between the stones, but this is certain that as the stones were usually four feet in diameter, the wheat in one passage between them, would be subjected to at least four feet of rough rubbing between flinty surfaces, involving necessarily, in spite of all precautions, the use of friction in an intense form. Very many skilful devices were adopted to minimise this friction, but but nothing that was done cured the inherent vice, rendered doubly vicious when brittle wheats were introduced, of excessive and unnecessary friction employed in grinding.

Fig. 7.



Section of Runner and Bedstone Face.

Fig. 8.



751 Half Cross Section of Diagonal Four Roll Mill with Reducing Rolls

Compare that with our modern methods of grinding by rolls (Fig. 8). They are made of chilled iron, and are usually but not invariably 10 inches in diameter, and of varying lengths according to capacity, from say 20 to 60 inches. For what we call break work, that is to say for the preliminary work of removing bran, the largest sized offal, from the broken kernel, they are corrugated in a way not unlike the teeth of a saw. To get a commercially complete separation of broken kernel from the bran, the wheat is passed through successive breaks. In the early days of roller milling these successive breaks were usually six in number, but to-day there are generally four. For the first break the corrugations of each roll are say 10 to 13 per inch of roll surface, and the two rolls are kept sufficiently far apart to break down the grains of wheat to say half or quarter their original size. For the last break the corrugations would be say 26 per inch, and the two rolls are made to run closely enough together to free the bran entirely of kernel according to commercial standards. The second and third breaks are intermediate as to their corrugations and adjustments. For each break both rolls revolve with usually a differential speed of 2½ to 1. Sometimes the two rolls are placed horizontally, sometimes vertically or practically so, but according to the latest development, or redevelopment on this technical point, they are placed diagonally one to the other. The object is to present the stock to the rolls in a perfectly even stream. For the purposes of comparison with the millstone, the essential points to be remembered are that the rolls are perfectly round, so that the whole of the grinding is done by one nip at the point of contact. Another essential point to be borne in mind is that at the point of contact the two rolls are moving in the same direction though at different speeds, so that the violence of the friction on the wheat is minimised as compared with the extreme violence of the friction applied by the two millstones, one stationary, the other revolving at a periphery speed of say 1,600 feet per minute. Still another essential point is that the minimised friction of the roller mill is applied at four successive operations in

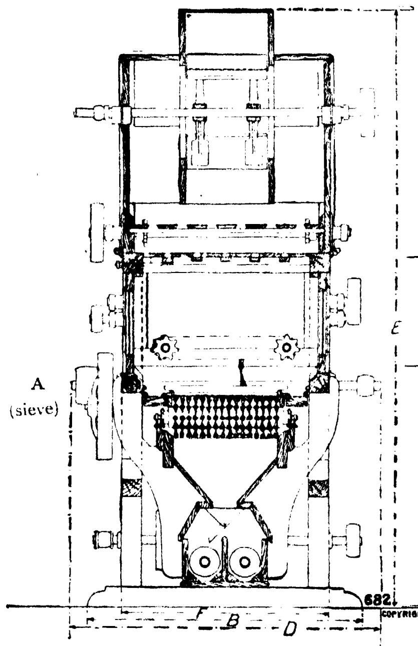
gradually increasing intensity, and that between each break those parts of the kernel which have been loosened and sufficiently broken down are removed by what we call "scalping" for further treatment separately.

The next principle to be noted is this. In our old methods we sought to make as much flour as possible at the first grinding, we now seek to make as little as possible in the breaks, that part of our processes which I have just been briefly describing. We cannot help making some flour there and that is removed as quickly as possible, but our real object is to obtain the kernel in a granular form, because we can thereby obtain a more perfect separation of husk from kernel.

Purification.

This brings me to the process known technically as purification. In essence it is an application of the principles of separation according to specific gravity. Given any number of particles of the same size obtained from the same wheat, their specific gravity will vary according to their quality, and indicate with sufficient accuracy the amount of grinding required to resolve them into finished flour and finished offal. In purification we apply wind currents capable of fine adjustment to this separation. Theoretically separations in this way might be applied to particles of any size, in practice owing to the difficulties of applying them to very small ones we make no attempt to apply purification in this technical sense to flour or to stock which will pass through the dressing medium made of silk possessing 13,000 holes to the square inch, but the particles which are larger than that up to those which will pass through a dressing medium, technically called a cover, containing 324 meshes to the square inch (18 to the lineal inch) are all purified. To ensure good work we have to grade carefully acccording to size, that is to say we remove all such fine particles as I have mentioned, and divide the larger ones up into various grades according to size, so that no one machine called a purifier has to handle particles varying greatly in size. These grades are known technically as semolinas, coarse or fine, and middlings, coarse or fine. The latter must not be confounded with the offal known in some districts by the same name. At various periods wind currents have been applied in various ways, but at present the almost invariable practice in Great Britain is to use them in combination with a sieve. The sieve, usually about 8 feet long and say 16 to 24 inches wide, is made to vibrate 450 to 500 times per minute. Its mechanical adjustments have to be fine and precise, so as to ensure a perfectly level, even, continuous flow of the stock over its surface. The cover of the sieve is usually made of silk, and its meshes vary in each section of the machine according to the stock to be purified, so that if the wind currents were shut off, the stock would be still sorted, according to size, in successive sections of the machine, and none of it would or should pass over the tail end of the sieve.

Fig. 9.



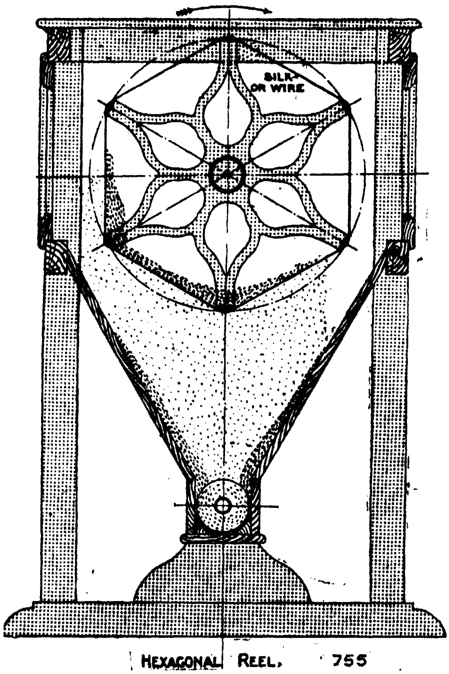
Each sieve is furnished with a fan, which draws air currents through the stock passing down the sieve. The lightest particles, finished offal, are taken up and deposited by themselves at B; particles of high specific gravity are not lifted by the wind currents, but pass through the cover to be reduced on smooth rolls. Particles of intermediate specific gravity are sorted out, and are either lifted on to trays placed immediately above the sieve at C, or carried over the tail end of the sieve, either into a receptacle for finished offal, or passed to rolls placed later in the process of grinding.

Flow Sheet.

This brings me back to rolls again, this time to machines similar in most respects to the

break rolls, but smooth in their grinding faces, and running at a lesser differential. In a large mill there may be hundreds of machines and mechanical appliances, but they are mutually inter-dependent, and form in essence one large machine, each unit essential to the whole. A drawing setting out their relation, one to the other, is called a flow sheet, and it takes a very clever miller to design a good one, that is to say in effect a mill capable of doing throughout the very best work required of it. I cannot therefore pretend to explain even to this educated audience the extremely com-

FIG. 10.

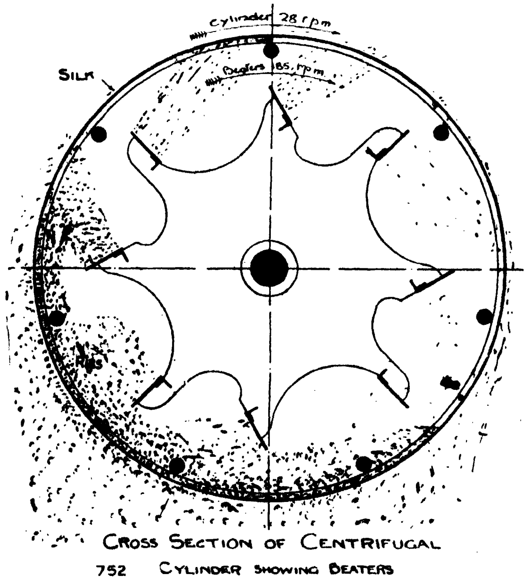


plicated flow of the stock through a modern mill. Suffice it to say that the many various divisions and subdivisions of stock according to size and specific gravity, receive after purification differing treatments. Some stock can be resolved into finished flour and finished offal by one grinding and dressing, others will get as many as seven. The essential principles are that each stock shall get sufficient grinding and no more, and that immediately it is resolved into finished product it shall be passed out of the processes altogether.

SCALPING AND DRESSING.

I have just spoken of grinding and purification. Incidentally I mentioned scalping and dressing. In these two processes, the same principle is applied, separation according to size. Scalping deals with coarser stocks, such as broken wheats in various stages of grinding, dressing in the technical sense is generally confined to the separation of finished flour from various stocks. After each grinding, the material ground is passed either to scalpers or dressers. The machines used are either reels, centrifugals, or plansifters. The reels are generally either circular or hexagonal (Fig. 10). A frame-work carrying the dressing medium or cover revolves at, say, 28 revolutions per minute. The slope of the machine causes the larger particles of the stock to pass longitudinally down the reel and over its tail

FIG. 11.



for subsequent treatment; the particles small enough to pass through the cover are carried off to a separate destination. The stock inside the reel rolls about the inner surface of the cover, or is lifted by the revolving of the machine and falls of its own gravity on to a fresh part of the cover. In a centrifugal, as it is called, centrifugal force is applied (Fig. 11).

That is to say, inside a round or hexagonal cylinder covered with wire or silk are beaters carried on arms fixed on a central shaft. Both the cylinder and the beaters revolve in the same direction, the former at, say, 28 revolutions per minute, the beaters at about 185. The amount of the centrifugal force applied by the beaters in this way is not nearly so severe as it may appear to be for two reasons. One is the

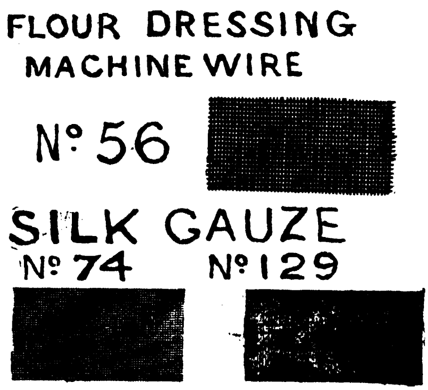
shape of the beaters, which are prevented from throwing the stock at right angles against the cover, the other because there is a clear space between the outside edge of the beaters and the cylinder. This means that the heavier particles are thrown against the cover with more force than particles of the same size of less specific gravity. This point is often overlooked in technical arguments, but it is a very real one, which can be proved by sifting the overtails of a centrifugal handling poor stock over a sieve covered with silk of the same mesh as the centrifugal itself is using, or even if the testing sieve be clothed rather more finely. The overtails contain particles of the same size as the flour which has passed through the cover of the centrifugal, but they are altogether inferior in quality.

Plansifters are in effect a number of sieves placed one above the other in a series and operated mechanically. They seek to reproduce as nearly as may be the effect of skilful hand-sifting, and theoretically there is a great deal to be said in their favour. They are largely used on the Continent and in America, and some firms of high repute use them in Great Britain, but speaking generally they have been discarded, after exhaustive trials, in the United Kingdom. Perhaps the sudden and many variations of our climate, or the variations of the wheats we have to use, are the cause of that, but whatever may be the cause our millers strongly prefer the more reliable and in practice simpler forms of dressing represented by the centrifugal.

For scalping it is possible to use with advantage an inclined plane set longtitudinally at varying angles, so that the stock to be scalped can fall, or, to be precise, can roll of its own gravity over the face of the cover. This is a recent application or reapplication of the all-pervading principle, the reduction of harmful friction to a minimum. We are constantly getting more or less successful attempts to do away with friction in handling.

The covers of these scalping and dressing machines are made either of wire or silk. Thirty years ago, wire or a cloth made of worsted, was almost exclusively used, and the meshes per lineal inch did not in common practice exceed 70, frequently did not exceed 56. This represents coarse dressing, and so long as the wheats used were mellow and approximately alike in their degree of hardness or mellowness it answered well enough. But when we began to get the harder wheats I have referred to, two important considerations came into effect. First the colour of the flour and bread went down, and that not only meant dark bread, but worse flavoured bread. Flour containing a lot of powdered husk is not nicer in flavour, but quite the reverse. Furthermore the baker found that his fermentations were prejudicially affected by the irregularities in texture of the flours made from a mixture of hard and soft wheats, and a further way to minimise such irregularities was to dress the flour more finely. For by any method of grinding a large proportion of fine particles is sure to be made. So as a first stage, even before rolls were introduced, millers began to use silk for dressing because it was possible with its very fine and strong threads to weave covers of far finer mesh. Makers of wire have now dis-

FIG. 12.



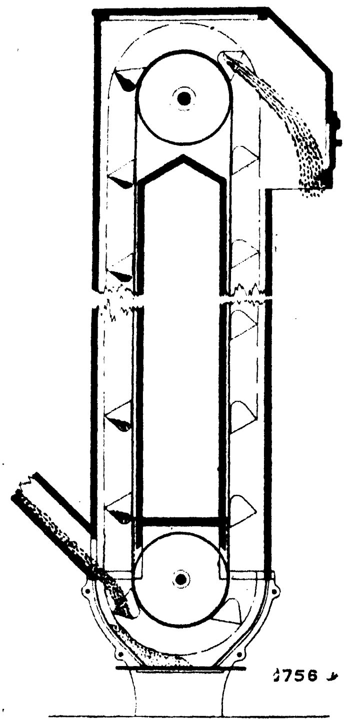
covered the way to make covers of extreme fineness of mesh, but practically all fine separations are made with silk manufactured mostly in certain districts of Switzerland. The finest numbers in ordinary use contain say 150 threads per lineal inch, or say with 22,500 holes per square inch. The illustration on the screen (Fig. 12) represents photographs of three pieces, each half an inch in height, of material used as dressing mediums. The one marked 56 is of wire, and represents, counting vertically, 28 meshes in the half-inch, a size of mesh commonly used thirty years or so ago. The one marked 74 is known commercially as No. 6 standard silk, and, counting vertically, there are 37 meshes in the half-inch photographed. This represents now exceedingly coarse dressing. The one marked 129 is known commercially as No. 13 standard silk, and that half-inch contains, say, 65 meshes, which represents fine—but not very fine—dressing according to modern practice. Here let me correct one false idea commonly

held by "food reformers." The highest-grade figures are not the most finely dressed according to modern practice. They are made from the semolinas and middlings, which are of the highest specific gravity and freest from husk. There is, therefore, no necessity for very fine dressing, and, as a matter of fact, the highest-grade flours as a class have been subjected to less grinding and are probably the most coarsely dressed flours made in a mill. It is the darker ones, call them "seconds" quality if you like, for which exceedingly fine dressing is used.

Of course, if fine dressing be used, more grinding has to be done, for the kernel has to be reduced to smaller-sized particles; but even then my point as to friction used in grinding holds good, for it must be remembered that rolls grind only at the point of contact, that the reduction rolls are smooth, and run at a small differential only, so their action is more nearly related to crushing than to grinding. Thus I come back to my great points, that in spite of a lengthened and a much more complicated process the most important principles lying at the root of modern milling are first and foremost, an immensely improved system of wheat-cleaning, and thereafter the use of far less friction in grinding, less in amount and far less in intensity.

One great change resulting from the adoption of modern methods is that modern mill buildings are altogether superior to old ones. They are not only larger in area, but possess higher floors, are better lighted and are altogether cleaner. Wheat cleaning is at best a dirty job, and in our modern mills it is carried on in separate or practically separate buildings, but our subsequent processes are carried on under incomparably better conditions than old time milling. From the time that wheat reaches the mill-warehouse until the products derived from it are delivered at the other end of the processes as finished articles ready for sale, they are not touched by hand. I have already said that directly any part of the wheat is resolved into finished flour or finished offal it should be removed from the processes, and as a consequence some of our products get very little milling, but that small proportion which has to pass through the whole length of our processes, travels a considerable distance, and is lifted from bottom to top of the mill many times. With the object of avoiding as far as possible the movement of stock by mechanical means, modern mills are high and

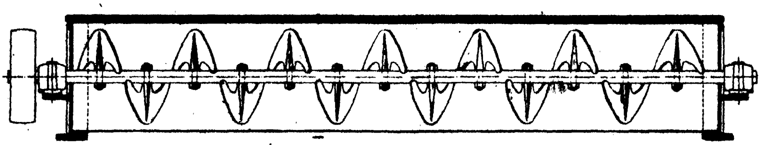
FIG. 13.



ELEVATOR

have high floors, so that stock can fall from floor to floor, and machine to machine in sequence, by its own gravity. The two implements most frequently used in the mill itself for moving stock automatically, are the elevator and the worm. The former is a travelling band, carrying cups which lift stock vertically, the worm is simply some form of archimedian screw, generally used for moving stock horizontally or upwards at a slight angle. We use other mechanical means

FIG. 14.



PADDLE WORM CONVEYOR

for moving stock about, but the illustration of the elevator and worm, gives a sufficient indication of the principal implements employed in such work (Figs. 13, 14).

BLEACHING.

I cannot omit from a description of modern developments of flour-milling a reference to bleaching. In some parts of the United Kingdom consumers demand a very white flour, and that demand cannot be satisfied by using wheats containing a high percentage of starch, because their correspondingly low percentage of nitrogen unfits them for the production of the highest qualities of flour. Furthermore many starchy wheats yield flours which are not white but yellow. This characteristic is not confined to wheats of the *durum* type, for many of the *triticum vulgare* genus possess it also. This extreme yellowness diminishes as the flour gets older. In some way or another Nature bleaches it to a very appreciable extent. Millers who bleach, seek to do within two or three minutes as part of the milling process, that which Nature does in several months. Bleaching, as its name simplies, whitens flour, but another important effect must be mentioned. Indeed M. Frichot, one of the earliest inventors in this field, seemed to regard the sterilising of the flour as more important than the whitening. His argument was that pure endosperm contains no active ferments, that these ferments which do harm to the flour, come from the aleurone cells and the germ. To produce flour containing a minimum percentage of these harmful ferments French millers extracted only a low percentage of flour from the wheats they used, allowing the aleurone cells to go into the offal, but if they could sterilize the flour and so destroy these ferments, they could extract from their wheats a much higher percentage of flour by putting into it the aleurone cells which contain a very high percentage of nitrogenous bodies. In that way he said they would obtain a flour of higher nutritive value, make a larger proportion of the wheat available for human food, and by a subsidiary but coincident result, whiten the product and make it suitable for those consumers who demand very white bread. I believe this is a fair summary of his arguments, and though I myself do not wish to express an opinion on them, or say that his premises correctly represent the practice of British millers, the point of view expressed and the effect claimed therein must be kept in mind when the question of bleaching is considered. The process is used to only a moderate extent in Great Britain. British millers hold sharply divided opinions as to its merits and demerits. As yet it is only in its infancy or adolescence, and inventors, millers, chemists, and electricians are far from being in agreement as to the actual bleaching agent or its operation. I am not concerned commercially, directly or indirectly, in any bleaching process, so can regard it as an interested outsider. One mechanical detail is common to all bleaching processes. The flour is kept loosely in motion inside a cylinder, and into that cylinder the bleaching agent is blown. In some processes this bleaching agent is a gas obtained by the action of chemicals, but the best known processes employ air blown or drawn through some form of electrical discharge, silent, sparking, or flaming. I am not a chemist or electrician, and will not venture to say what it is which gives to that air its power to bleach. It may be ozone or oxides of nitrogen. Around that innocent-looking problem a considerable controversy rages. Authorities are not agreed on the points whether it is the ozone present that bleaches or which cannot bleach, or whether it be peroxide of nitrogen which does the work, or which imparts to the ozone, existing side by side with it, the power to do so. Furthermore, the controversy does not end there, for it has not as yet been ascertained with precision how the flour is affected. The weight of any flour passed through the process is not appreciably altered, so that the bleaching would appear to be due to a change in the appearance of some constituent, or constituents. Here also I can express no opinion, for authorities differ as to whether it is due to oxidation or not, and as to whether the actual bleaching is caused by the decoloration of the fatty matter itself, or whether through the fatty matter being rendered transparent the white colour of the starch is more apparent to the observer. It seems to be agreed that the effect is due to some change wrought on the fatty matters. Millers who use the process at all seem, according to most recent practice, to bleach to a very moderate extent only, or to restrict its use to the flours produced from wheats with very yellow endosperms. Air containing one part in 13,000 of ozone and one part in 40,000 of oxides of nitrogen, principally peroxide, will bleach perfectly according to most recent ideas. There is nothing nasty in the process itself, or in the

flavour of the bread produced from properly bleached flour. Bleaching certainly makes flour whiter—that is to say, white according to the precise signification of the term, the hue of chalk not of cream—a point which does not appeal to many first-class millers and bakers; it seems to improve the keeping qualities of flour, and inventors of the highest standing claim that in some unexplained manner flour when bleached will make more bread than it will do in its untreated condition.

Dietetic Value.

The question may now be asked, are these modern developments of flour-milling harmful to the consumer? No one, we may be sure, will object to the improvements in wheat-cleaning, so that a large proportion of our modern developments can most assuredly be esteemed wholly good. The controversy will centre round the all-pervading endeavour of the modern miller to produce flour as free from husk as possible. That is, apart from improved wheat-cleaning, the great line of advance from our point of view. I will speak of the relative food values of whole-meal bread and white bread, because upon those I propose to base an important argument bearing upon the point at issue, but whole-meal bread was not thirty years ago, is not now, and is not likely to be, an article of diet used to any great or even appreciable extent. Basing an opinion upon the amount of trade done by millers in wheat meals, I do not think that whole-meal breads represent more than 2 per cent., perhaps only 1 to 1½ per cent., of the total bread consumed in England, in spite of the long-continued campaign of food reformers in its favour. The human digestive apparatus seems to rebel against its use as a regular article of diet, pleasant though it is as an occasional variation on white bread, and useful though it may be to those who, from constitutional or acquired infirmity, require a mild irritant to bring about improved peristaltic action. The best market in the United Kingdom for the highest grades of flour is not London, but the mining and manufacturing districts of South Wales and the North, where great physical exertions are made by the consumers.

There are several points to be considered in connection with this question of dietetic value. Let me take a very few important ones. First of all, consider the function of the husk in the economy of Nature. Man has a multitude of things from which to choose his articles of diet. Nature, so far as wheat is concerned, is, it is fair to say, far more anxious to perpetuate the species than to care whether man eats the whole berry or only 70 per cent. of it. Wheat is a particularly hardy plant. We sow it when the conditions of climate and soil are unfavourable to the existence of delicate seeds, in wet, cold ground. The germ, say 1½ per cent. of the whole berry, is the source from which the young plant originates; the endosperm, call it the flour if you please to do so, is the food of the baby plant until it is old enough and strong enough to get its sustenance from soil and air. The husk is the cover provided by Nature to protect the food of the baby plant in surroundings unfavourable to its preservation. So we find this protecting cover constituted largely of woody fibre, able to resist disintegration; in other words relatively indigestible. I noticed a few days ago in examining wheat which had been planted about six weeks ago and had grown several inches long above ground, that attached to each plant was the husk only of the seed, the endosperm appeared to have been quite consumed by the growth of the plant, but the husk in every case I examined was practically intact. We need have no hesitation in discarding it for human food. Give it as we do to animals, say to the cow which chews its cud, and take back for our own consumption a large part of the nutriment it contains as milk and beef.

Take another point. The average consumer finds wheatmeal bread more or less unpalatable, yet the wheatmeal of commerce is made from picked wheats. British millers get very few wheats from which saleable wheatmeal can be made. Those we use are chosen largely because of their excellent flavour. The average wheats we use for flour-making would not make the whole-meal breads of commerce but something of relatively very poor flavour. Do not gather from that statement that our ordinary wheats are inferior in food value to those used for wheatmeal. The latter contain, as a class, less nitrogen than those from which white bread is made.

Another point is worth noting. Nearly all the brown breads of commerce are baked in tins, and this implies that they contain more water than average white breads, and water should be cheap, but in those cases it is not so.

These matters have a bearing on the questions at issue, but are not, as I have already said, the real points themselves; for the comparison to be made is not between wheat-meal and white flour, but between millstone-made

flour and roller-made flour. The latter contains less husk than the former, and you may not improperly think that it is a substantially different case to the one concerning whole meal.

The first consideration to be borne in mind is, or at least should be, an obvious one. Samples taken at haphazard of millstone-made and roller-made flours, may be perfectly fair specimens of their respective kinds, but they cannot be used as illustrations of the effects of the respective processes, unless the same wheats be used in both cases. There are many hundreds of varieties of wheat, and each variety can be more or less affected by an enormous number of variations in natural conditions, such as climate, soil, water supply, &c. I must confess that the literature on the points involved seems to be a maze. I will attempt to reduce the problem to a simple form, and the first great simplifier is the condition just mentioned.

Let me interpose these facts. The wheats we grind nowadays contain more nitrogen than those in common use thirty years ago. The increased whiteness of modern bread is not due to the use of more starchy wheats. Those starchy wheats, as we have already seen, do not invariably make white-looking flours, and anyhow it is impossible to make bread of the highest quality from those wheats only, which contain a high proportion of starch. You may have noticed that the bread made from average English wheat was substantially darker than that made from Fife wheat, even though both were roller made, yet the flour itself from the average English was much whiter in appearance than the Fife flour. It was lack of strength, in other words and with sufficient accuracy, its lack of nitrogen, which accounted for the relatively dark appearance of the average English in bread. If the two sorts were mixed with a substantial proportion of very strong flour in exactly the same proportions, the average English in the blend would yield bread quite as good in colour as the Fife in the blend. A relatively high nitrogen content is necessary for the production of the higher qualities of bread.

To get at the truth of the case, I milled the two types of wheat already referred to—the one mellow, the other hard—and sent the wheats, the flours produced therefrom, and loaves corresponding to those I have shown you, to my good friend, Mr. A. D. Hall, of Rothamsted, with whom I have had the pleasure of collaborating in other matters for some years. He has very kindly analysed the complete set for me, and you will see in the published reports of these proceedings the analyses he has sent me. The results are more favourable to modern milling than I anticipated. You may have gathered already that the millstone-made flour from the mellow wheat contained less powdered husk than the flour made from the harder wheats by millstones. Mr. Hall's analyses show that the flour made by rolls from the mellow wheat contains quite as much nitrogen as the flour made by millstones from the same wheat, but that in the case of the hard wheat, the millstone-made flour contained more nitrogen than the roller-made. That arises from the larger proportion of powdered husk which the former contains. In modern milling we frequently separate the different qualities of flour made from one and the same wheat, into at least two grades known in Great Britain generically as "patents" and "bakers." The former is much better in colour, loosely called whiter, than the "bakers" grade. Here is a loaf made from the "patents" produced from the harder wheat of the two analysed. As I anticipated, it contains less nitrogen than the "bakers" grade, and substantially less than the wheat from which it was made, which may be taken to represent the analysis of wheat meal if the wheat in question had been converted into that product. It appears, therefore, that our modern processes have in some cases diminished the percentage of nitrogen in the white flours, particularly so in the higher grades of flour. If the chemist were the final arbiter in the matter, modern millers would have to admit that to that extent we are doing something to the detriment of the consumer. But let us get to grips. What have we done to bring about that result?

Germ.

Dealing with a small matter first, we have abstracted the germ more or less perfectly. I use the qualifying words because in extracting it we have rolled it three or four times and probably have passed some of it by abrasion, and some of its fatty matter by exudation into the flour. It is commonly believed that in the old processes germ was passed into the flour. We certainly did not extract it as a separate product, and because we did not see it, a good many believed it went there. But that is true to a moderate extent only. Germ retains its characteristic stickiness, due to the oil it contains, whatever process of milling be used and

as the millstones in spite of their relatively rough handling of wheat did nevertheless produce a large percentage of good bran, we have no real reason to think they ground up the germ so finely that it all went into the flour. If the intermediate product I referred to were treated separately, a substantial quantity of germ could be and actually in the later days of millstone milling was extracted, but besides that, a proportion of it then as now was inextricably mixed up with the finished offal and was disposed of in that way. It could be seen by a magnifying glass in the offal, but to put the matter beyond doubt I took a great amount of trouble to treat the finished offal obtained by millstone grinding from the harder wheat of the two milled and analysed, and here is a sample of practically pure germ obtained from it. Girard gave the percentage of germ contained in wheat as 1·46 per cent. say 1½ per cent. It contains a high percentage of nitrogen and fatty matter, and, *primâ facie*, its abstraction is a loss to the consumer. Millers extract it because it contains some active ferments which prejudicially affect flour. The War Office found that out for itself in South Africa, and one of our trade papers, *Milling*, of Liverpool, has put it on record that the military authorities abandoned buying lower grade flours for that campaign and bought patent flours only, because they kept so much better than the lower grades. The exact difference in the proportion of germ which found its way into flour in millstone days and that which finds its way there now has, so far as I know, never been ascertained. Millers extract about ½ per cent. as a separate product, and the remaining 1 per cent. finds its way into offal or into the lower grades of flour. Anyhow the difference between the nitrogen of wheat and the nitrogen of germ has to be divided by a large divisor to arrive at the infinitesimal harm done in theory to the average of the whole and the importance of this has again to be whittled down owing to the harm which the ferments in the germ may do to the flour if it be stored for any length of time.

Digestibility of Breads.

A point in the argument far more important than that concerning germ, is the one concerning the finely divided husk found in flours made by both processes, but of which there is a far larger proportion in millstone-made flour. To present the case in its simplest form, let me state it in this way, The highest grade flour produced by modern methods from any wheat is practically pure endosperm. We may with sufficient accuracy regard the analysis of such flour as that of the endosperm itself. The commercial grade of offal which is the nearest approach to pure husk is bran. It probably has attached to it a considerable proportion of the aleurone cells but that does not vitiate my argument. Between these two extremes are many grades or qualities of flour of which the main distinguishing feature is a diminishing commercial value, due to the fact that as the quality falls so the proportion of husk they contain increases. Clifford Richardson several years ago made analyses of 88 products including the wheat used, obtained from various parts of a roller process mill. In an appendix to the printed report you will see a few of his most important results. Dealing with proteids first I may now mention that the wheat contained 14·35 per cent., the patent flour 12·95 per cent., the bakers' grade 14·88 per cent., bran 16·28 per cent. of proteid matter. Of ash the wheat contained 1·79 per cent., the patent flour ·39 per cent., the bakers' grade ·62 per cent., the bran 5·59 per cent. The same sort of progression is to be noted in connection with the ether extract, and inversely with the carbohydrates. The argument becomes involved if we take into account the proportion and the chemical constitution of the aleurone cells, so I intentionally omit further reference to them. The moral I want to draw from these figures is that the highest percentages of proteid, ash, and ether extract, are to be found in the bran, the lowest in the highest grade flours. As the percentage of husk in the flour rises, so the percentages of the constituents I have just named rise also. If, therefore, the food value coincides with the percentages of these constituents ascertained by chemical analysis, then our modern methods of milling would in fact operate to the detriment of the consumer. But that is just where chemical analysis break down. It does not indicate the food value of these products, in other words the human digestive apparatus works on lines of its own which tell a different tale to that told by the chemist. British scientists have made laboratory experiments on the relative digestibility of various breads, and the results they have obtained agree in the main with the elaborate experiments I will now summarize.

The University of Minnesota, situated in one

of the great wheat-growing districts of the world, has made scores of experiments in this way. Various wheats have been taken, and from them, what we should call wholemeal, wholemeal less the largest pieces of bran, and white flour have been made. Men engaged at different kinds of labour, were induced to live for four days upon rations composed of milk, and the various breads made from these products. The foods taken, were weighed and analysed, the weights of the individuals noted, and their urine and fæces weighed and analysed. The fæces were examined microscopically also. The following sentence, adapted to our English nomenclature, gives the results of these trials. While wholemeal, and wholemeal minus the largest pieces of bran, contain more proteid and fat and have a "higher heat of combustion" they actually yield to the body because of their lower digestibility, smaller percentages of digestible nutrients and available energy than the white flour. These results were the same in every case. That seems to be conclusive as to the wholemeal breads; it does not exhaust the point at issue between millstone-made and roller-made flours. That has been dealt with also. Bran was finely pulverised and mixed with white flour and digestive experiments carried out as in the last-mentioned cases. The flour containing finely pulverised bran was more digestible than the coarsely granulated wholemeal, but less digestible than the white flour without the admixture. "When bran was finely pulverised it failed to digest as completely as the white flour and therefore the addition of bran lowered the food value of the flour." That seems to me to show that in excluding, so far as we can, husk from flour, we are not doing harm to the consumer but good.

I can only deal with one more point. We are told that white flour is the cause of bad teeth, because it contains relatively so little mineral constituents. That seems to me as unlikely as the statement that tomatoes are the cause of the increase of cancer. There have been very many other changes in our articles of diet. For instance, how about the large quantities of sugar consumed nowadays and the fact that so many infants do not now receive their natural food? The questions concerning the digestibility of ash are being dealt with in a similar way to that I have just described, and as yet the results are not known. I can, however, point out that it is contained principally in the husk, and if the human digestive apparatus fails to extract the other constituents from the husk we may reasonably anticipate that it would fail to extract the ash. Moreover, it is open to question whether the ash is in a form which can be assimilated by animals or human beings, and even if it should be so, it seems that white flour contains sufficient phosphates to meet all the demands of the human body. If that be so any additional amount supplied to the body would have to be excreted by the kidneys in a practically unchanged form. However that may be, a statement I came across in some American literature is interesting. The negro of the South lives upon a diet which contains far less phosphates than are found in white flour, yet the teeth of the negro are generally sound and white and do not show any lack of phosphates.

At any rate "I practice what I preach." For my own consumption I insist on having the best coloured bread obtainable, for I think it is the nicest, its appearance is a palpable guarantee of cleanliness, and I believe I am assimilating the greatest amount of nutriment obtainable from wheaten bread with the least possible strain on my digestive organs.

APPENDIX A.—Analyses made by A. D. Hall, M.A., at Rothamsted (December 1906).

	Per cent. nitrogen reckoned as proteid.	Per cent. nitrogen reckoned as proteid in dry bread.	Per cent. moisture in bread.
Average English grain	11·3	—	—
,, millstone-made flour	9·8	10·15	33·91
,, roller-made flour	9·9	10·01	32·80
Fife wheat, grown for the fifth consecutive year in England	12·7	—	—
,, millstone-made flour	12·7	12·9	34·00
,, roller-made flour	11·9	12·4	33·27
,, highest grade roller-made flour	11·6	11·7	37·35
Typical whole wheat meal	12·7	14·7	38·18

APPENDIX B.—ANALYSES BY CLIFFORD RICHARDSON.

(Extracted from Bulletin No. 13, issued by the United States Department of Agriculture, Division of Chemistry).

	Wheat used (cleaned).	Chop from first break.	Chop from second break.	Chop from third break.	Chop from fourth break.	Chop from fifth break.	Chop from sixth break.	Bran 18 per cent. to 24 per cent. of the wheat.	Shorts, fine offal, 1 to 4 per cent. of the wheat.	Germ.	"Bakers" flour.	"Patent" flour (a mixture of the best grades made from the wheat).*
Proteids	14·35	12·95	12·60	12·78	14·18	15·75	17·68	16·28	16·80	33·25	14·88	12·95
Ash	1·79	·88	·57	·78	1·47	1·99	3·29	5·59	3·41	5·45	·62	·39
Ether extract	2·74	2·08	1·68	1·86	2·87	4·16	4·92	5·03	4·67	15·61	2·00	1·45
Carbohydrates	70·37	70·44	71·82	71·10	67·90	64·46	59·09	56·21	60·28	35·19	69·99	73·55
Fibre	1·68	1·13	·55	·78	1·23	1·73	3·18	5·98	3·90	1·75	·33	·18
Moisture	9·07	12·52	12·78	12·70	12·35	11·91	11·84	10·91	10·94	8·75	12·18	11·48
	100·	100·	100·	100·	100·	100·	100·	100·	100·	100·	100·	100·
Phosphoric acid	·82	·46	·34	·42	·75	1·01	1·66	2·78	1·62	2·57	·31	·18

DISCUSSION.

The CHAIRMAN, in opening the discussion, regretted that he had a comparatively slight knowledge of milling machinery, having picked up the little he did possess from the author in conversations he had had with him on the subject. He was interested in the subject from two points of view, the grower's and the consumer's. From the latter's point of view he quite agreed with the conclusions stated by the author, viz., that the amount of nourishment to be derived from the English white loaf of to-day was quite as great as that which was derived from the loaf made fifty years ago. It might be the case that the loaf of to-day had not the flavour it had when manufactured entirely from English wheat as it was fifty years ago; on that he could not pass an opinion, but he had very carefully studied the question of the food value of the present-day loaf, and it seemed to him that the case for white bread had been entirely made out. He had no sympathy with those who stated that the English grower of wheat had a grievance, because the labourer of the present day was supplied with bread which was not so nourishing as that which was consumed by his father. From the grower's point of view, there were some things to which the author had alluded with which he (the speaker) was not so well satisfied. The author had stated that the millstone, which was very suitable in machines for grinding the wheats of England thirty or forty years ago, was quite unsuited for dealing with the wheats the miller desired to grind at the present time; in other words, modern milling machinery was fitted to deal with a class of wheat which the English farmer did not grow. That was a thing which those interested in English agriculture must regret. A great deal of attention had been given within the past few years to the production of English wheats which themselves would possess the qualities of the mixed wheats which the millers now converted into the flour used for baking purposes. This was a subject which was outside the one under discussion, but it might be of interest if he stated that, with the help of the author, the Cambridge University Department of Agriculture was now producing types of English wheat which were fitted for modern English milling machinery, and for the modern bakehouse.

Mr. BRYAN CORCORAN said that milling in the olden times required skill and dexterity, but the knowledge now needed was more scientific and less empirical. The aim of the old miller was to make as much flour as he could at one operation, with as few middlings as possible while cleaning the bran. The whole of the meal passed through a flour-dressing machine, the waste offals going on to a jumper, which was simply a screen, the whole of the products thus being obtained. Now the operation might be said to be quite different. Low grinding with millstones was in operation at the present time, but in the old days high grinding with millstones was in vogue, the difficulty with the latter being that there was less fine flour and more middlings, the middlings being the cause of the trouble. With the low grinding the fine middlings remained in the flour, and some people seemed to think that that added to the flavour. In the high grinding process, all those products, except the first flour that was produced, had to go through successive operations afterwards, and when the flour was produced they were passed back with the other flour. He thought the roll-milling process consisted in cutting up the wheat into small pieces successively by passing it through fluted rollers, so that all but the hard portions were taken away after each rolling and treated again. By that process a certain amount of clean white semolina was produced, which only needed to be reduced to form flour; that flour could be dressed coarsely and was better ground than English. To get back the other products involved a

great many different processes. Undoubtedly the flour produced was very much cleaner and whiter than it used to be, and it satisfied the baker, which seemed to him the only thing that was necessary. As a consumer he would certainly prefer the old-fashioned way, but from a business point of view the more scientific way of getting a purer and whiter article was the desirable thing.

Mr. W. A. VERNON thought the subject of the paper was very little known to the public, and in many ways misunderstood. As the author had very clearly shown, the milling of the present day was far superior to that of years past, the millers having entered into the subject from a scientific point of view. Very few members of the ordinary public appreciated the vast amount of work which had been done for them by the miller in cleaning the wheat and eliminating all extraneous dirt, while by the action of air all the light material was removed, and only the best part of the kernel left for consumption. The finest proteids and the most nutritious part of the grain only, were given in the highest quality of flour, which naturally was the best for human food. He thought the paper would enlighten most people on the subject of the food they ate in the form of bread.

Mr. A. D. HENDERSON thought English people liked to have varieties in diet, and if for no other reason than that he considered that meal breads in various forms were extremely useful, it not being desirable to tie the people of this country down entirely to the use of white bread. The question of stone-made flour had been referred to in the paper, and, in his opinion, stones were very useful for grinding soft wheats, and such wheats as were grown in this country.

Lieut.-Colonel ALLAN CUNNINGHAM desired to contrast the highly scientific process of grinding in use at the present day in all civilised counties with the unscientific process of grinding on a very large scale amongst the huge population of North-West India, which was essentially a wheat-eating population. The wheat was ground there in hand stone mills; the grinding was coarse, and separation of the bran very imperfect, there being a good deal of bran in the so-called flour. The bread was unleavened bread, whereas the bread eaten in this country was leavened bread, which made an immense difference in its effect on the constitution. The native flour was simply kneaded with water, and quickly heated over a griddle. With the addition of a little milk, butter, and salt, that was the staple food of the population. The effect of the diet was that the population were inferior on the whole in physique to Europeans, but it must be remembered that they did not have a varied diet. The people had extremely beautiful teeth which they carefully cleaned. One very curious effect. which was always ascribed to the eating of the native ground wheat, was that the natives were extraordinarily subject to stone, even little children frequently having big stones in the bladder.

Mr. R. SCHINDLER thought the paper gave a great deal of instruction which was very much needed, and wished the points made in the paper could be brought prominently before the attention of the public. The British public was not simply ignorant on the question of the production of flour and bread, but was absolutely misinformed, and labouring under serious misconceptions. A change had taken place in the attitude of the people of this country towards industrial processes. Years ago people did not trouble about how things were produced, but now they wished to know the ins and outs of everything, with the result that newspapers and popular magazines, which were always ready to do what the public wanted, had undertaken to gratify their curiosity. Unfortunately, the journalist who wrote articles on the subject very seldom thought it necessary to obtain any information. About 30 years ago he went into a vegetarian restaurant, and was presented with a short pamphlet setting forth the iniquities of eating white bread; and many of the leading articles which appeared in the present day in the daily papers were simply a repetition of that old pamphlet. Journalists seemed to have no regard for what had happened since that time, not one of them apparently being aware of the experimnts of Professor Schneider, which proved that the facts were in opposition to their theories. The newspapers were perpetually confusing the question of the amount of nutriment in a given material with the amount of nutriment obtained from it, two entirely different things. For instance, sheep fed on grass, and it was hardly possible to find anything less nutritious than such food, and yet from that food, so largely deficient in nutrition and weak in proteids, the sheep managed to make some most nitrogenous mutton abounding in proteids. Another great fallacy which newspapers always indulged in, was that they seemed to think the question of the nutritious character of bread was a matter of very great importance. As a matter of fact it was only of slight importance, because the total quantity of bread consumed was not very large, statistics showing that the consumption of bread in a working man's family amounted to less than one-seventh of his food consumption. One interesting point raised in the paper was the question of growing wheats in England which would produce a hard berry. Experiments were still being carried on, and he hoped the author would soon be in a position to give information on that interesting subject.

Mr. R. A. SIDLEY remarked that when he started flour-milling in Lancashire, nothing but millstones were used, and it was a very rare occurrence to get a sack of English wheat. He therefore thought it could not be contended that roll mills had done the

English farmer so much harm as they contended. The lay press seemed to think that English millers were trying to give the people of this country poison for amusement, and did not give them the credit for making the article which was demanded. In his opinion the farmers had done very little to improve their methods, and he did not believe that, if Mr. Humphries discovered a suitable wheat for them, they would grow it, because they were the most unprogressive part of the community.

Mr. WILLIAM MARK said it had always been the custom in this country to put flour in sacks of 20 stones, but the difficulty at the present day was to find men who could carry such a sack of flour on their backs. He suggested that millers now used what they called bags or half-sacks, because of the impossibility of finding men who could carry a heavy sack of flour He brought the question forward in order to ask, from the standpoint of a food reformer, whether there was any ground for the supposition that it was the ultra purity of the flour on which Englishmen were fed which deprived them of the stamina to enable them to carry 20 stones of flour. While giving every credit to the millers of England for the splendid manner in which they provided the article demanded by the consumer, he did not think it was any detriment to the miller to suggest that perhaps the demand of the consumer was wrong. He suggested it was not a question of what flour the millers should make for English consumers, but what flour the English consumers would be well advised to consume. It was necessary to get a little further back to nature, and to take a lesson from the people of North-West India, to which Colonel Cunningham had referred, where large sections of the population lived almost entirely upon cereals. He maintained that far more was to be feared from the half-starved populations of the world than from the overfed and dyspeptic nations. For instance, the people on the American continent were celebrated for patent foods and patent medicines, but he did not think very much was to be feared from them as a competitive nation. On the other hand, half-starved Germans and the people of Silesia—who fed on wheat, and, if the supply failed, on rye—displayed the qualities which used to be the characteristics of Englishmen, and which he was afraid, from personal observation, were not now obtainable at a salary of 25s. a week.

Mr. FRANCIS DAVIES thought it might be of interest if he stated, in reply to the last speaker's remarks, that some years ago a test was made in California as to the amount of work which men could do in carrying heavy weights and light weight, and it was found that a very much greater amount of work could be done in a given time, with less fatigue, by using small rather than large sacks. He therefore thought the reduction in the size of the sack was not a proof that the men had deteriorated from using white flour. The modern mill was a labour-saving appliance, which in one way was not a benefit to the working population; but it enabled the miller to produce flour at a much cheaper rate, and he could, therefore, sell it at a less price to the buyer who bought the product. In old times people were satisfied with a very poor class of product, the stone mills not doing justice to the wheat, but, at the present time, with the modern roller mill, quite as good results could be obtained from English wheat as were ever obtained in the past. The author had referred to dirt remaining in the inside crease of the wheat. A brush would not take off that dirt, but it must be removed by what was called the first break. A certain amount of flour came away in that break with the dirt which was in the crease; but anyone who desired to escape eating that dirt, could do so by using only the highest class of flour, because the first break flour never found its way into that article.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Humphries for his exceedingly able and instructive paper, said the author stood in the very front rank of his profession, and was looked upon as one of the authorities on the subject of milling and the milling industry. Mr. Humphries had taken a leading part in connection with the work which had been carried on for the last ten years for the improvement of wheat. The work had been carried out in part by an Association, of which Mr. Humphries was chairman, and in part by the Agricultural Department of the University of Cambridge and the Experimental Station at Rothamsted. The scientific workers regarded Mr. Humphries as their much trusted technical adviser, and he was one whose advice had been of the greatest possible value and assistance.

The resolution was then put and carried unanimously.

Mr. HUMPHRIES, after thanking the audience for the exceedingly kind manner in which his paper had been received, stated that Mr. Mark inquired whether it was a fact that the demand for half-sacks was due to the weakness of the carmen. That was not the case, the demand being made seven to eight years ago from the bakers, who sent in something in the nature of an ultimatum to the millers, that if the flour were not put into half-sacks they would not deal with them. It was a very curious coincidence that the millers had an appeal made to them by the carmen of London, 105 of whom signed a round robin saying that they desired the full sack to be continued, only two being in favour of the half-sack. The carmen preferred carrying the full sack to the half-sack because it saved them so much time in delivery. Colonel Cunningham had referred to a new and

interesting point. He (Mr. Humphries) had been suggesting that if a man lived wholly on white bread he would get sufficent ash from it fully to satisfy the demands of nature in that direction. The Indian people evidently took more ash than English people did, and suffered badly from stone as a consequence. If that was caused from an overdose of food which contained an excess of ash, personally he would rather eat wheat flour such as was produced in this country. The main point to which he desired to call attention was, that it was supposed that modern milling was detrimental to the farmer because it could not deal with soft wheats. That was an absolute fallacy, for which there was not the slightest ground of suspicion. The roll mill could tackle anything that a stone mill could tackle, It might easily happen that the wheat was too soft altogether for the millstone, but the roll mill, although it would not do such good work upon that soft stuff as it would do upon wheat properly mellowed and in good condition, would do better work than the millstone could do. Another speaker had said that modern processes spoiled the flavour. He did not agree with that suggestion for one moment, for the reason that he had several times taken flours and milled them, first by one process and then by another, and at the finish he could not tell the difference in flavour between them. It was an undoubted fact, however, that the whiter bread was invariably better flavoured than the dark bread, the latter having a distinctly bitter taste, the characteristic of the addition of bran. The hard wheats which broke up into fine particles, extreme darkness being obtained owing to the presence of husk, undoubtedly gave a worse and not a better flavour. Referring to a remark made by the Chairman, Fife wheat had been grown in England for five years in succession, and had not lost its hardness, and wheat had been grown in England for fourteen years which had not lost its hardness. As a matter of fact, hardness and high nutriment did not go hand in hand. Some of the hard wheats of India had a low nitrogenous content; but, speaking in a general way, the Fife wheats grown in England were actually not only a more saleable article, but a better article from the dietetic point of view. He had had analyses made of wheats grown side by side, and the Fife wheats showed they contained 2½ per cent. more glutin than the soft wheats. Manuring did not enter into the question at all; it was simply and solely the fact that the harder wheats did manage by some method to extract from Nature more nitrogen than the other wheats grown alongside, although the soil and the treatment by the farmer were exactly the same. English millers, so far from wishing in any way to depreciate the value of English wheat had, for the last five years, spent a great amount of time and trouble, fortunately with every prospect of success, in raising in England wheat that should be equal to the best American wheats and, in addition, from the dietetic point of view, actually more nourishing because they contained a far higher percentage of nitrogenous products.

ARTS AND CRAFTS.

Furniture.—In the recent movement in industrial art which has covered pretty well the whole field of artistic manufacture in this country, furniture has not by any means lagged behind. Indeed, nowadays fashions change almost as rapidly in furniture as they do in frocks. In place of the old-fashioned mahogany suite we have all sorts and kinds of novelties. In fact it is easy enough for anyone who knows anything about it to say, in looking at a modern room, about how long ago it was furnished, or rather when the furniture was bought. We have had, of course, work of the most up-to-date kind, good, bad, and indifferent thrust upon us for some time past, and there have been in connection with this kind of furniture some interesting developments, both of the form of the objects and of the method of decorating them. But all the time, side by side with the modern movement, there has been a distinctly antiquarian one. We have suffered from what amounts almost to a mania for Chippendale, Sheraton, and other furniture of the eighteenth and nineteenth centuries. Better by far a Chippendale chair, no matter how ricketty and shaky and useless, than any modern production, be it never so useful or so well proportioned. What did it matter if the legs were stuck fast with glue, so long as the piece of furniture was a real antique. That was all very well some time back, when real pieces of old work were to be picked up at a reasonable price and in good condition. But of recent years that has been quite impossible, and the ordinary householder with a taste for Sheraton, or Hepplewhite, let alone Chippendale, has been obliged to content himself with modern imitations. And thus, side by side with the wildest of modern individualistic furniture, we have had quantities not merely of adaptations, but of direct copies of the work of the celebrated makers of the Georgian period. Further, the taste for this kind of thing has been fostered (or has it, perhaps, been a cause?) by the present desire for what is called in some quarters "early English design"—a term commercially applied to work not earlier than the Jacobean, and sometimes as late as the Victorian, period. For some two years now, wallpapers, cretonnes, and hangings of various sorts in the style of Jacobean crewel work, or in the more naturalistic manner of the days of our great grandmothers have been in great demand—and designs which some time ago would have been dubbed old-fashioned and hideous are now declared to be quaint and delightful. People with common sense or taste naturally realised that if somewhat obtrusively modern hangings, covers, and wallpapers would not go well with Chippendale and Sheraton chairs and tables, neither did furniture of an up-to-date type fit happily into rooms papered with wreaths of roses and bunches of flowers, or upholstered in the "last thing" in Victorian chintzes. Modern Chippendale and inlaid Sheraton furniture have been with us for some time now, and in the natural course of events

they are being followed by work of a somewhat later period.

Satinwood Furniture.—Satinwood was first imported from the East Indies somewhere about the end of the eighteenth century. The beautiful marking of the wood quickly brought it into popularity for small tables, chairs, and other articles of furniture, and the taste of the day settled its treatment. Table tops and other flat surfaces were occasionally left bare, to show the beauty of the wood; sometimes they were enriched with tulip wood—or some other kind of inlay. But it was a time when the painter was in high favour. Cipriani, Angelica Kauffmann and others were busily working in England—and a certain amount of quite elaborately painted furniture was being made by Sheraton, Heppelwhite, and others. Thus it was by painting that this new satinwood furniture was mainly decorated—and the painting was in the style in vogue at the moment. Painted medallions were largely employed, and these were filled with cupids, scenes from classical fables, and other subjects in fashion; whilst swags, wreaths, garlands, masks, musical instruments, and such like motives provide the ornamental portion of the decoration. The modern productions in satinwood, which are filling the shop windows from Bond-street to Tottenham-court-road, are strictly on the lines of the old. Indeed, they are largely copies of old examples both in shape and decoration. In a few cases, the wood is so arranged that the waving lines of its markings form a pattern—occasionally a little inlay is judiciously used in borders and such like, but the largest part of the work is painted, and rather heavily painted, too. It seems a pity that, in the case of a wood so beautiful both in marking and in colour as satinwood, the wood is not more often left (as it was in the best old work) free from paint. The decoration may recall the old work, it may be in keeping with the style of the furniture, but it does not add to the beauty of the texture or the surface of the material. Painting on wood, moreover, however satisfactory it may be for the time, cannot in the nature of things have the same lasting qualities as inlay. It always seems rather odd that more has not been done in the way of slightly grounding out the design, so that the painted parts would not be on the same level as the wood surface. This would have the double advantage of making the paint less likely to wear off, since it would be in a less exposed position, and of rendering its renewal easier when it had worn off.

Silversmiths' Work.—Silversmiths' work is perhaps the craft above all others in which the modern English artist-craftsman can be said to have really found himself and evolved a style which, without being extravagant or *outré*, is really distinctive and original—a style, too, which has a simple dignity of its own. This may be due in part to the fact that some of our most successful artistic silversmiths are workmen, who have arrived at art by way of mastery of their trade, and not artists who have taken to craftsmanship. It is at this season of the year that we really have he best chance of seeing what is being done by the different workers. Many of the galleries contain cases of work by well known craftsmen, and some of the makers have special shows at their own studios. Of course, the season, and the demand for Christmas presents at a fairly moderate price, affects the character of these various exhibits. A good number of the objects shown are small and unimportant — but the forks, spoons, serviette rings, salt cellars, mustard pots, and the like are often far better in design than anything it would have been possible to buy in days not long gone by, and the prices sometimes compare not unfavourably with those charged for ordinary trade work. And, these small things designed to appeal rather to the casual purchaser, though numerically more important, are not the mainstay of the shows. Artists so deservedly well known as Messrs. Car and Ramsden, Mr. Spencer, and Mr. Nelson Dawson, to mention only a few names, are naturally not content to be represented entirely by work of a comparatively trivial kind; and it is satisfactory to notice that work is being done for ecclesiastical purposes, as vigorous as it is dignified, which, though markedly original and individual, keeps its own place, and would not be conspicuously and hopelessly out of place in fairly ordinary surroundings. The cross and candlesticks for the Bishop of Rochester, the Rochester Diocesan crozier, the mace for the Bishop of Southwark, the pastoral staff for the Bishop of London, and a really beautiful sanctuary lamp—all of which have been on view during the last few weeks, are works which make one feel that here is a craft which is very much alive indeed, and is being carried on by earnest and competent workmen, who, while working on their own lines, are not afraid of looking at what has been done before by the masters of long ago. Here are men possessed of an individuality which is strong enough to take care of itself and has, therefore, no need to be afraid of being lost when it comes in contact with other minds. On the whole the least satisfactory part of the more serious silversmiths' work is the enamel, which often looks too trivial and tinselly for its setting. One cannot help wondering whether on rather massive work, opaque *champlevé* enamel would not be more in keeping than translucent *cloisonné*. But, as a certain amount of *champlevé* enamel is now being made, we may hope at no very distant date to have a chance of seeing how it looks on the silversmiths' work of the twentieth century. Finally, it is hopeful to see that, when a craft is carried on by working artists, who consider their craft as seriously as they do their art—and who have thought it worth while to study it as seriously—they not only find a market for their work, but do something towards levelling up the standard of ordinary trade production—and so have a real effect upon the output of the country as a whole.

CORRESPONDENCE.

OBJECTIONS TO THE COMPULSORY INTRODUCTION OF THE METRIC SYSTEM.

I observe by your issue of the 14th inst. that you have opened your columns to correspondents who desire to add to the recent discussion on this subject. May I, therefore, hope that you will find space for the accompanying letter from a firm of silk merchants who deal with the statement made by Col. Sir C. M. Watson as to the continued use of the "aune" and "denier" in that industry. It appears to me to be as reasonable to claim that the metric system is unsuitable for general use because in France some old names are still used for new measures, as it would be to say that English is not a suitable language for our commerce, because the Welsh language is still spoken in some of the mountain districts in Wales.

The mention of Herbert Spencer's name commands universal respect and consideration, but Mr. R. Kaye Gray, who quotes from Spencer, cannot agree with him (whose chief objection to the adoption of the metric weights and measures was based on a preference for a duodecimal system), and at the same time advocate a decimal system based on the inch as the unit. If anyone still believes that a duodecimal system is possible, let him construct a multiplication table, and he will not have proceeded far before he realises the impossibility of such a project.

Perhaps you will allow me to reproduce one table, using therein the signs, "T" and "E," to represent 10 and 11.

4 × 1 = 4
4 × 2 = 8
4 × 3 = 10
4 × 4 = 14
4 × 5 = 18
4 × 6 = 20
4 × 7 = 24
4 × 8 = 28
4 × 9 = 30
4 × T = 34
4 × E = 38
4 × 10 = 40 (*i.e.*, our present 48.)

One speaker at the recent meeting read a letter from Messrs. Willans and Robinson stating their reasons for opposing the adoption of the metric weights and measures. I am not able to trace any argument against the metric weights and measures being used for commercial purposes, in the announcement of this firm.

The use of the metric system in the workshops in question was entirely a voluntary matter, and the fact that Messrs. Willans and Robinson had to use two systems of course added to their expenses. If their English as well as Continental customers had used the metric system while they (Messrs. Willans and Robinson) did, I doubt whether there would have been any recantation by this firm.

But no one proposes to make it obligatory on any manufacturer to construct engines, machines, or cotton goods to the metric scale, that is altogether a different thing from buying and selling by that system.

Messrs. Willans and Robinson said that their workmen had no difficulty in using the metric measures, and they still use the metric system, they say, for their continental trade. Quite so, this supports our case.

It is strange that this important firm should be supporting an Association which admits the need for a reform of our weights and measures, and advocates a new British system based on the inch as a unit, the inference being that Messrs. Willans and Robinson are prepared to try that scheme in their works.

To remove some misunderstanding, I should like to say that the firm named were not members of the Decimal Association, and to add that there are firms still which use the metric system entirely in their works in this country.

E. JOHNSON,
Secretary, Decimal Association.

Oxford-court, Cannon-street, London. E.C.
December 18th, 1906.

The Secretary,
Decimal Association,
London, E.C.

32, Snow-hill, E.C.,
December 13th, 106.

DEAR SIR,

In reading the paper by Col. Sir C. M. Watson, before the Society of Arts, on some objections to the metric system, we notice that one of the points he made against the metric system was, that in France the metric standard had not completely replaced the old measures, giving as a practical instance the silk industry, in which "the skeins are still based for length on the 'aune' and for weight on the 'denier.'"

As silk merchants having to deal daily with these matters, and having a practical experience of them both in France and Italy, we wish to state that Sir C. M. Watson is under an entire misapprehension. Silk yarn, it is true, is sized by the denier, but the denier itself, as officially recognised all over the globe, is based on the metric system. The denier represents a weight of 0·05 grammes per 450 metres of silk Thus, if a silk yarn is stated to be 20 deniers, this means that 450 metres of the silk weigh 0·05 × 20 = 1 gramme. Although in a few of the private reeling establishments in Lyons it is still customary to give the size in the old denier, which was in force before the introduction of the present system; in such cases the official denier is always stated as well on the reeling notes under the title "titre legal," and anyone giving the size in deniers is always understood to mean the official measure.

As regards the length of the skeins, this may be originally based on the "aune," but when referred to it is invariably the custom to give the measure in centimetres. Further, when the length of yarn to the skein is a fixed quantity, it is invariably a definite number of thousand metres—usually 10,000.

Under these circumstances it is difficult to see where Sir C. M. Watson's contention comes in, so far as the silk trade is concerned.

Yours faithfully,
(Signed) RHEINBERG & Co.

GENERAL NOTES.

CANALS AND WATERWAYS.—A statement appeared in the *Journal* of 7th December, to the effect that the Royal Commission on Canals and Waterways had completed its investigations so far as England is concerned. This is incorrect, and indeed is inconsistent with the statement contained in the Report itself that later on it is proposed to hear further witnesses from England, Wales, and Scotland. Since the date of the Report, the Commission, it is understood, have held sittings in Ireland as well as in London. They have now adjourned till February next, when it is believed that they will have further evidence about Ireland, Scotland, and Wales, and a large amount of evidence about canals and waterways. It is also believed that the Commission would welcome further evidence from representatives of important industries who are interested in water transport on account of its cheapness, and if, therefore, there are any Members of the Society connected with the coal and iron trades, or with other manufactures and industries relying upon cheap transport, who have not yet given evidence before the Commission, and are in a position to do so, it would be as well for them to take steps to bring their views before the Commission, the address of which is 54, Victoria-street, S.W.

NOBEL PEACE PRIZE.—The Board of Education have received through the Foreign Office an intimation that, in order to be eligible for the Nobel Peace Prize, which will be awarded in December, 1907, candidates must be proposed to the Nobel Committee of the Norwegian Parliament before February 1st next. The following persons alone are qualified to recommend candidates:—1. Past and present members of the Nobel Committee of the Norwegian Parliament, as well as members of the Advisory Board of the Nobel Institute. 2. Members of the Legislatures and Governments of different countries, as well as members of the Conseil Interparlementaire. 3. Members of the International Arbitration Court at the Hague. 4. Members of the Commission of the International Peace Bureau. 5. Members of the Institute of International Law. 6. University Professors of law and political science, of history and philosophy. 7. Persons who have received the Nobel Peace Prize. The Nobel Peace Prize can be granted to an institution or an association, not only to an individual Inquiries for further information should be addressed to the Comité Nobel du Parlement norvégien, Drammensvei 19, Kristriania, Norway.

SIAM.—In reporting upon affairs in Siam (Cd. 2682) Mr. Acting Consul Lyle refers to an interesting feature in the distribution of cotton goods, namely the rise of a class of Indian packmen. These individuals are spreading on all sides of the river and railway highways hawking goods, and the Chinese trader of the Delta and the Provinces is beginning to find his position seriously menaced. Through these men the British Indian cotton trade is yearly obtaining a greater control of the retail cotton market. In steel bars, plates, girders, &c., the local demand is increasing, more particularly for girders, which are rapidly taking the place of teak for building purposes, owing to the very high price and increasing demand for teak on the home market. Steel is also gradually but slowly replacing teak for lighters, cargo boats, and small steamers. During 1905, milling machinery for eleven rice mills, averaging £5,000 per mill, was imported or ordered. Of this £35,000 was British and about £18,000 German. There has been a noticeable increase in the value of the imports of cycles and motors—from £1,023 in 1904 to £22,127 in 1905. The cars which have found their way to Bangkok, though of Continental makes, have been for the most part secured through British agencies. It is surprising that German shipping does the larger part of the carrying trade with Siam. Last year the proportion carried in German bottoms was 64 per cent., Norway coming next with 17 per cent., the British per centage being only 11 per cent.

CHEFOO AND KIAOCHOU.—The trade of Chefoo would seem to be seriously threatened by Kiaochou. In his report on the trade of the former port for the years 1903-5, Mr. Consul O'Brien Butler says that the Germans are sparing neither money nor trade in preparing Kiaochou to become a rival to Chefoo. The harbour at Chefoo is at present in a lamentable condition, being exposed to the strong northerly winds which prevail during the winter, and having no facilities for loading and unloading cargo. It is very difficult to tranship cargo in severe weather, and the delays which are thus caused prove very serious to shipping. At Kiaochou, on the other hand, a magnificent harbour has been built, with wharves and warehouses, and with the additional advantage that goods can be landed from the ship direct into railway trucks. Kiaochou is also in communication with Chuan Fu, the provincial capital, and thus possesses a great natural advantage over Chefoo, both with regard to import and export trade. It is, therefore, of great importance that Chefoo should be provided with some effective harbour improvement without delay if she is to maintain her position.

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FRIDAY, DECEMBER 28, 1906.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 2, 5 p.m. (Juvenile Lectures), BENNETT H. BROUGH, "Perils and Adventures Underground."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

The usual short course of lectures adapted for a juvenile audience will be delivered on Wednesday afternoons, January 2nd and 9th, at 5 o'clock, by BENNETT H. BROUGH, F.G.S., F.I.C., F.C.S., on "Perils and Adventures Underground."

Each Member is entitled to a ticket admitting two children and an adult. A sufficient number of tickets to fill the room will be issued to Members in the order in which applications are received. Members who desire tickets for the course are requested to apply for them at once.

PROCEEDINGS OF THE SOCIETY.

ARTIFICIAL FERTILISERS: THEIR NATURE AND FUNCTION.

BY A. D. HALL, M.A.,
Director of the Rothamsted Experimental Station, Lawes Agricultural Trust.

Lecture I.—Delivered November 19, 1906.

THE NUTRITION OF THE PLANT.

In talking of an artificial manure, one has a perfectly clear idea of the meaning of the term ; to find, however, a satisfactory definition is by no means easy. To the farmer certainly it means something which he receives in bags and applies to the land in hundredweights rather than tons per acre. With these two ideas in our mind—that we are dealing with an article of commerce, and with a concentrated one—we may dispense with any more formal definition of what constitutes an artificial fertiliser.

Nor, with the limited time at our disposal, need we spend much time over the early history of artificial manures. Men of an experimental turn of mind must have been putting all sorts of things on their land from the beginning of time. The virtues of gypsum and bones were certainly known to the Romans ; and, to come down to more modern times, we find a man like William Ellis, writing in 1736, was well acquainted with the use of such bodies as woollen rags, bones, soot, malt dust, and oil cake residues as manures. The real history of artificial fertilisers begins with the nineteenth century, because not until then was the knowledge of chemistry sufficiently advanced to provide any basis for a theory of the nutrition of the plant. Without such a theory all observation of the good effect of this or that substance on the crop was merely empiric and possessed no value beyond the occasion.

To trace the building up of our accepted conception of the course of a plant's nutrition would have an interesting story, in which Priestley, de Saussure, and Liebig are the outstanding names, though many others played their parts, either creative or controversial ; but it would require a lecture for itself. In the main, though there are bye-paths still to be explored, the great issues may be considered as settled ; indeed they are just beginning to receive the final sanction of age and orthodoxy in the shape of the assaults of the crank, who starting *de novo*, rediscovers all the errors and fallacies which the old masters had patiently and laboriously cleared away.

If we take any living plant and reduce it to its elements we find but a small range of substances; water forms the greatest portion of the plant, the rest is almost wholly composed of

compounds of carbon with hydrogen and oxygen, approximately in the proportions which make up water. Of the dry matter of the plant at least half is carbon; oxygen and hydrogen constitute most of the remainder; then a certain restricted number of other elements are present in much smaller quantities. Nitrogen constitutes 2 per cent. of the dry matter; the others, which are found in the ash when the plant is burnt, make up a further 2 per cent. These ash constituents comprise sulphur, phosphorus, silicon, and chlorine among the non-metals; potassium, sodium, calcium, magnesium, and a little iron and manganese among the metals. Traces of other metals occur from time to time in the ashes of plants growing on soils which happen to contain them, but they are unessential and may in this connection be neglected.

H. T. Brown, the leaf, which may still be attached to the plant, is enclosed in a flat air-tight box with glass sides, through which sweeps a rapid but measured current of air. The issuing air which has passed over the leaf is led into an apparatus for the determination of the carbonic acid (and if need be of the water) it contains; at the same time a parallel experiment without the leaf measures the proportion of carbonic acid and water in the incoming air. Thus the amount of carbonic acid absorbed, and therefore decomposed, in a given time by a leaf, whose area can be afterwards measured, is directly determined, and such factors as illumination, temperature, can be varied at will. The energetics of the process have been worked out by Dr. Brown and Mr. Escombe, from whose paper the following examples have been selected :—

TABLE I.

Plant.	CO_2 absorbed per sq. dm. of leaf per hour, c.c.	Water transpired. Grams.	Energy in calories per sq. cm. of leaf per minute.				
			Solar radiation falling on leaf.	Solar radiation absorbed by leaf.	Energy required for assimilation.	Energy required for transpiration.	Energy lost by radiation and convection.
Polygonum, June 19....	3·758	1·054	0·1942	0·1256	0·0031	0·1041	0·0184
Tropæolum, September 4	1·498	0·141	0·0889	0·0622	0·0012	0·0139	0·0471
Helianthus, August 4 ..	2·134	1·259	0·2569	0·1762	0·0017	0·1243	0·0502

Carbon then is the main element in the plant's economy, and we know that it is obtained by the plant from the carbonic acid in the atmosphere, through the agency of the living cells in the leaf which contain green chlorophyll. The carbonic acid is taken in through the small openings in the skin of the leaf, the stomata; it is decomposed by the chlorophyll-containing cells and the carbon is retained in combination with the elements of water, so that it is first identifiable as sugar and then as starch, at the same time oxygen is returned to the atmosphere. This decomposition is one which necessitates an external supply of energy, which is found to be derived from the light incident upon the leaf, the process stopping in darkness, and for low illuminations becoming proportional to the amount of light falling upon the leaf.

The conditions affecting this process of photo-synthesis, the fundamental reaction of the whole plant world, have been subjected to considerable examination of late. In the method which has been adopted by Dr.

These experiments show that the leaf of a plant is not to be regarded as a very efficient machine for the decomposition of carbonic acid, since in no case was more than 1·66 per cent. of the total incident energy on the leaf used for photo-synthesis, so that even dull, diffuse daylight can amply provide a growing plant with the energy it wants for assimilation. The process, however, is limited by many factors, any one of which may fix a minimum rate at which assimilation will take place, however favourable the other conditions are. Temperature, the supply of water, the proportion of carbonic acid in the air, the number and area of the stomatic openings, are all limiting factors of this kind, as also is the supply of other nutriment to the plant. To take an example which bears more particularly on the subject of these lectures: if we compare two of the Rothamsted mangel plots (see Table II.), which receive the same supply of nitrogen and phosphoric acid, we find that they produce approximately the same weight of leaf, indeed the similarity would be

still closer if the comparison were made when the leaves were in full activity, and not at the end of the growing season. One plot, however, receives a dressing of potash salts, but not the other, and the plot with potash produces nearly 2½ times the weight of roots grown upon the other plot without potash. Now this difference in weight is almost wholly due to sugar and other carbo-hydrates, which were manufactured in the leaf and then passed on to the root for storage, yet the two plots possessed practically the same leaf development working under identical conditions of illumination, carbon dioxide, and water supply. But in one case the photo-synthetical process had been limited by the want of potash; all the machinery was there and the power was in excess, but the machinery was running idle for the lack of one necessary link—in this case the potash. (See Table II.)

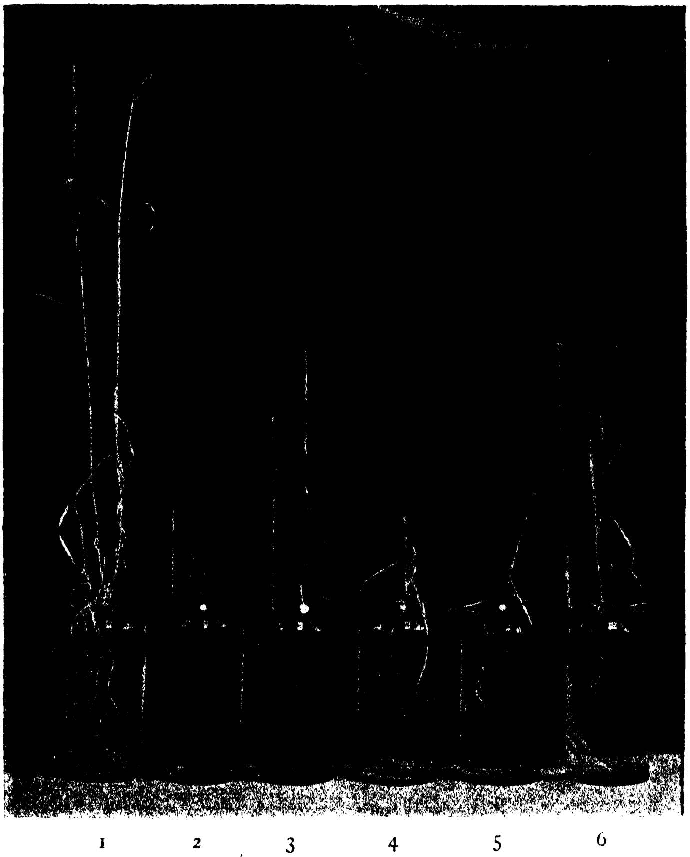
TABLE II.

PRODUCE OF MANGELS AT ROTHAMSTED, 1900.

Plot.	Manure.	Leaf per Acre.	Roots per Acre.	Sugar per Acre.
		Tons.	Tons.	Tons.
5A	Nitrate of soda & superphosphate	2·95	12·00	0·797
4A	Nitrate of soda, superphosphate & potash	3·25	28·95	2·223

Though the compounds of carbon with hydrogen and oxygen make up so much of the solid matter of the plant, the remaining substances, comparatively small in amount as they are, are still all important to the process of growth. The part they respectively play and their mode of entry can best be illustrated by the method of water cultures, of which Fig. 1 shows an example. By this

FIG. 1.



WATER CULTURES OF BARLEY.

1. Complete manure.
2. No nitrogen.
3. No phosphoric acid.
4. No potash.
5. No lime.
6. No magnesia.

method the roots of young seedling plants are just allowed to dip into a large jar of water in which salts of the elements found in the plant are dissolved. A complete solution might be made up as follows :—

	Grammes per litre.
Calcium nitrate	0·7
Potassium phosphate	0·6
Potassium chloride	0·8
Magnesium sulphate	0·3

with a trace of ferric chloride.

This will contain all the elements, except silicon, normally found in plant ashes, and under such conditions the plant will grow and go through its whole cycle of life, assimilating freely, producing large quantities of dry matter, setting flowers, and ripening healthy seed. Certain precautions have to be taken, but if the right conditions are assured, the growth of a plant in a water culture is perfectly normal, and may be taken, as far as the plant is concerned, as representing the course of its nutrition in the field. The advantage of the method lies in the fact that it is possible to vary the composition of the nutrient solution by omitting in turn from successive jars each of the salts used in making up the complete solution, thus obtaining media for the plant containing no nitrogen, no phosphorus, no potassium, &c., the other constituents found in the plant being present in each case. The result of one such series of experiments is shown in Fig. 1, which illustrates that when, *e.g.*, nitrates are omitted from the culture solution the plant is quite unable to grow after it has used up the material in the seed, however freely it may have been provided with potassium, magnesium, &c. The nett result of such experiments, in agreement with the one shown in the photograph, is that a plant must obtain by means of its root its nitrogen and its ash constituents from simple inorganic compounds dissolved in the water.

Of the elements found in the plant, nitrogen in combination, phosphorus, sulphur, potassium, magnesium, calcium and a little iron are indispensable to the growth of the plant and cannot be omitted from the culture solutions. Sodium, silicon, and probably chlorine, though invariable constituents of the ash, are not necessary and can be dispensed with. From these water-culture experiments we arrive, then, at the conclusion that the plant must draw certain elements, in quantities which are small indeed compared with the weight of the crop but nevertheless indispensable, out of the soil by means of its roots, the rest of the plant being built up from air and water. The further deduction would appear to be simple, that the manure a plant wants will consist simply in these bodies, other than carbon, hydrogen, and oxygen, which are mainly left behind when a plant is burnt. Indeed, it was on these lines that Liebig, who first of all devised a theory of manuring, proceeded to construct an artificial fertiliser. Put into the soil, he said, exactly what a good crop of the kind normally removes, and you have satisfied all the manurial conditions necessary for a maximum crop; and on this basis manures were compounded for the various crops, which, however, failed to satisfy the farmer who used them. Not only did Liebig's own manures prove a failure, but his theory of manuring was rudely traversed by the field experiments which Lawes and Gilbert had just begun in this country. His theory, indeed, true enough for a water culture, breaks down in the field because it takes no account of the soil; and the soil is not merely an inert medium to anchor the plant and convey the manure to it when convenient, but contains itself an enormous potential reserve of plant food.

We may take, by way of an example, the Rothamsted soil. On the one hand, it is neither richer nor poorer than the majority of British soils and it has no abnormal characteristic, but may be taken as a very fair average type; on the other hand, there is no other soil about which so much knowledge has been accumulated.

The accompanying analysis shows, as usual, that the greater part of the soil consists of insoluble siliceous matter of which no account need be taken; there is further a certain amount of organic material, important as containing a store of nitrogen which may eventually reach the plant. In addition, we have various acids and salts going into solution in the acids used for the analytical process, and these include precisely the substances that have already been indicated as constituents of the ash of plants; amongst metals, calcium, magnesium, potassium, sodium, with iron and aluminium in quite disproportionate amounts, sulphuric and phosphoric acids, chlorine and silica to supply the non-metals. Read as percentages, some of these amounts seem small enough, but they represent enormous quantities of material in the soil, as will be realised when they are correlated with the fact that the layer of soil at Rothamsted, nine inches deep,

which is taken for analysis, weighs over the area of one acre rather more than two and a half million pounds. Translating, then, the percentages into pounds per acre, 0·1 per cent. of nitrogen becomes 2,500 lb., 0·11 of phosphoric acid becomes 2,750 lb., and the potash rises to 6,750 lb.; also these quantities are in the surface soil only without considering the lower layers into which the plant roots penetrate

TABLE III.—Analysis of the Soil of Broadbalk Field, Rothamsted, Unmanured for 50 Years.

	Per Cent.	Per Cent.	Lb. per Acre.
Loss on Ignition	4·20	..	..
Containing Carbon ..	..	0·89	22,250
,, Nitrogen ..	..	0·10	2,500
Matter soluble in hydrochloric acid	12·53	..	..
Containing Soda ..	..	0·06	1,500
,, Potash ..	..	0·27	6,750
,, Magnesia.	..	0·36	9,000
,, Lime	..	2·49	62,250
,, Alumina ·	..	4·49	112,250
,, Oxide of iron ..	.	3·40	85,000
,, Phosphoric acid	..	0·11	2,750
,, Sulphuric acid ..	..	0·05	1,250
,, Carbonic acid ..	..	1·30	32,500
Undissolved siliceous matter	83·27	..	..

freely. A comparison of the materials in the soil with those taken away by ordinary crops at once leads to results which seem paradoxical, so much greater is the stock of plant food in the soil than any requirements of the crop that further additions of the same stuff in the shape of fertilisers would seem to be needless. The accompanying Table (IV.) shows the amounts of various materials per acre which are on the average drawn from the soil by various crops at Rothamsted.[4]

Roughly speaking an average soil contains enough plant food for a hundred full crops, yet without fresh additions of plant food as manures the production will shrink in a very few years to one-third or one-fourth of the average full crop. Once, however, the yield has reached this lower level it will remain comparatively stationary, affected only by the fluctuations due to season, for an indefinite period. At Rothamsted, for example, wheat has now been grown year after year on the same land for sixty-three seasons, and one plot has received no manure throughout the whole period. In the first few years the crop declined steadily, but since then little or no further drop can be seen. The yield remains at about 12½ bushels per acre for each successive ten years' average, and has considerably overtopped that amount during the last two favourable seasons. This yield, however, of 12½ bushels of corn per acre is only about a third of that obtained on the adjacent plots receiving manure every year during the same period.

These facts lead to a new point of view. I is not merely the amount of this or that plant food present in the soil which must be taken

TABLE IV.—Soil Constituents contained in Average Crops.

	Wheat	Barley.	Swedes	Mangels.	Hay.
Crop .... Tons	2·2	2·0	16·1	30·1	1·5
Nitrogen ...lb.	50	49	98	149	49
Soda ......lb.	2·6	5·0	32·0	118·7	9·2
Potash ....lb.	28·8	35·7	79·7	300·7	50·9
Magnesia ..lb.	7·1	6·9	9·2	42·5	14·4
Lime ......lb.	9·2	9·2	42·4	42·9	32·1
Phosphoric acid lb.	21·1	20·7	21·7	52·9	12·3
Sulphur ....lb.	7·8	6·1	17·8	14·0	5·7
Chlorine ....lb.	2·5	4·1	15·1	83·1	14·6
Silica .....lb.	96·9	68·6	6·7	17·9	56·9

into account, but also their mode of combination. The material may be present in the soil and soluble in the acid used for analysis, but yet may be beyond the reach of the plant in a locked up or dormant condition. The plant can only obtain substances which have been previously dissolved in the water contained by soils in the field, hence plant food in the soil is only available for the plant in so far as it can pass into solution. It has been maintained that the roots of the plant itself, in virtue of the acid cell-sap they contain, are capable of exerting a strong solvent action on such insoluble materials of plant nutrition as calcium phosphate, but investigations of this question from various points of view lead to the conclusion that no such external action of the root sap is possible, but that the carbon dioxide excreted by the roots does assist the solvent action of the soil water. The apparent paradox of a soil being poor or impoverished while

yet containing enough plant food to furnish a hundred crops or more is thus explained by the comparative insolubility of these reserves, which can only become available to the plant by passing into solution. To use an illustration, the plant food in the soil may be represented by the capital a man may have locked up in a particular business, the available plant food will correspond to the cash in hand, which may often run dangerously short, however great the capital involved. Similarly a good many of the operations of cultivation have for their end the bringing of the capital of the soil into a circulating form as rapidly as possible and the realisation of a profit from it.

Accepting then the fact that the soil contains a vast store of all the elements necessary to its nutrition but in forms more or less available, it remains to ascertain which of the substances are normally likely to fall below the current requirements of the crop. This is a question that can only be solved by field experiments, and though the solution will vary with each crop and each soil, yet certain general principles at once become evident, and upon them the whole idea of a fertiliser is based. For example, field experiments at once show that certain elements indispensable to the plant, as seen from water-culture experiments, need not be supplied to the crop in the field, since the soil is practically always able to provide a sufficiency. Calcium, magnesium, iron, sulphur, chlorine, and silicon fall into this class; to judge by field experiments alone there are only three elements necessary to the nutrition of the crop, nitrogen, phosphorus, and potassium, which means that soils can usually supply enough of the elements necessary to the plant excepting only of these three. Fertilisers, then, are designed to supply deficiencies in the soil and for all practical purposes are to be regarded as containing compounds of nitrogen, phosphoric acid, and potash, either singly or together. They may also contain magnesia, lime, or sulphuric acid, but these, though equally necessary to the plant, are not counted, since the unaided soil may be trusted to furnish the crop with them.

To illustrate the part played by the soil, a comparison may be drawn between the water-cultures of barley previously illustrated and the results of the Rothamsted experiments upon the same crop grown continuously for over fifty years on the same land. The same series of nutrient substances were employed in both cases, and in the field trials, as in the water-cultures, the part played by any element can best be seen from the result produced by omitting it from a complete manure.

TABLE V.—Experiments upon Barley, Hoos Field, Rothamsted.

Plot.	Character of manuring.	Yield—Bushels of Grain.	
		Whole period 51 years.	Last 10 years only.
1-O	Unmanured	15·3	10·1
4-O	Without nitrogen	20·4	12·4
3-A	Without phosphoric acid	29·4	20·8
2-A	Without potash	39·9	26·8
4-A	Complete manure	42·1	35·1

From this it will be seen that the soil alone is capable of producing a crop which, if small, yet amounts to over a third of that obtained with a complete manure. The omission of potash results in a small diminution of crop, the omission of phosphoric acid in a much larger one, while in the absence of nitrogen the yield falls to less than half, almost to that of the unmanured plot. Of course, in a water-culture the omission of any one of these elements would have reduced the growth to a minimum; in the field the soil has been able to meet the requirements of the plant fairly well as regards potash, less so for phosphoric acid, and very indifferently as regards nitrogen. That the soil is drawing in capital to supply the crop may be seen by comparing the results from the omission of potash over the whole period, and for the last ten years; over the whole period the decline in the yield produced by the omission of potash is only 5·2 per cent, but during the last decade this decline has risen to 23·6 per cent., an indication that the supply of potash originally available for the crop has been largely exhausted.

This experiment also illustrates another difficulty that is experienced in framing a theory of fertilisers; the analysis of a plant, though it would enable one to make up a solution suitable for its growth in water-culture, is no guide to the amounts of the various fertilisers to be supplied to the same plant when growing as a field crop. For example, analysis shows that an average barley crop removes from the soil about 49 lbs. of nitrogen, 21 lbs. of phosphoric acid, and 36 lbs. of potash per acre; yet the addition of 43 lbs. of nitrogen raises the crop from 20·4 to 42·1 bushels per acre, or by 51·5 per cent. of the crop on the standard completely-manured crop; the addi-

tion of 63lbs. of phosphoric acid produces an increase of 12·7 bushels; while the addition of 100 lbs. of potash, the element most abundant in the ash, only causes an increased yield of 5·2 per cent.

To take another example. An average crop of swedes will remove from the soil 98 lbs. of nitrogen, 22 lbs. of phosphoric acid, and 80 lbs. of potash; but, so far from the swede crop requiring a fertiliser which is mainly nitrogenons and potassic, all field experiments and long farming experience go to show that swedes require little beyond phosphoric acid as a manure, with a small amount of nitrogen and potash only in rare cases.

No theory of fertilisers then can be based on the composition of the plant alone. The amount of plant food must also be taken into account, and not only its amount but its availability, which will vary to a considerable extent with the different crops. Growing plants of different species show widely differing powers of obtaining for themselves from the reserves in the soil the quantity of this or that plant food which they require; those differences depending on such factors as the depth or extent of the root range, the duration of growth and the period of the year at which it takes place, &c. For example, compare the effect of withholding potash in the fertiliser from three of the crops under experiment at Rothamsted — wheat, barley, and mangels.

TABLE VI.—Effect of Potash on various crops grown continuously.

	Manures. Nitrogen and phosphoric acid.	Manures. Nitrogen phosphoric acid and potash.	Per cent. increase due to potash.	Potash, pound per acre removed by crop (average).
	Yield. (bushels)	Yield. (bushels)		
Wheat ...... (51 years)	24·0	31·5	31·2	28·8
Barley ...... (51 years)	39·9	42·1	5·2	35·7
	(tons.)	(tons.)		
Mangels ..... (27 years)	7·66	14·03	83·2	300·7

As all three crops are grown on soils which are practically identical, this Table shows that barley is much better able to use the reserves of potash in the soil than are either wheat or mangels, the latter crop being particularly dependent upon a large supply of potash in the fertiliser.

The fertiliser that a crop particularly requires is the substance that it finds some special difficulty in obtaining from the reserves in the soil; and this difficulty may be indicated by a comparative deficiency of the substance in question in the plant's analysis, just as the swede crop, which is particularly in need of phosphoric acid, only removes of it 22 lbs. per acre, as against 98 lbs. of nitrogen and 80 lbs. of potash.

But while it is true that for each of our farm crops we can indicate what Ville has called a "dominant" fertiliser, nitrogen for wheat, phosphoric acid for swedes, potash and nitrogen for mangels, meaning thereby that if the crop is well supplied with its "dominant" by means of fertilisers, it can generally pick up the remaining elements of nutrition from the soil reserves, yet this "dominant" is hardly to be discovered from a consideration of the analysis of the plant. Field experiments form the only guide to the manurial requirements of any plant, field experiments carried on for a sufficient length of time to eliminate accidental variations in the results due to soil and season. Such field experiments have been carried out for wheat, barley, oats, grass, potatoes, mangels and turnips; but for many other crops of considerable importance, particularly in market gardening, this fundamental knowledge of the plant requirements has not yet been ascertained.

A complete theory of manuring will always have two points of view, one special to the crop, the other to the soil; on good all-round soils, fertile loams and the like, the composition of the fertiliser employed will be dictated by the nature of the crop; on the more specialised soils, as on the pure sands, heavy clays or peats, it will depend primarily upon the soil.

It is on these special soils that Liebig's "law of the minimum" is chiefly seen to operate; if any one of the elements necessary to a plant's nutrition is deficient then it is the supply of that particular substance which will determine the yield of the crop, however abundant the other elements may be. This law of the minimum may, indeed, be extended more widely to include other factors than the supply of fertilisers; temperature, water-supply, the texture of the soil, are all "limiting factors" in the nutrition of the plant, any one of which may so determine its growth that variations in the other factors are of no account. Thus it is not uncommonly seen that in an exceptionally dry season a series of experimental plots may show little or no variation in the results

due to the different manures; on each plot the crop grows as far as the limited water supply will allow it, and for this small development there is in each case an excess of all kinds of plant food to be obtained from the soil. In a wetter season of abundant growth it may be the supply of potash or phosphoric acid gives out on one or other plot, whereupon that becomes the limiting factor determining the yield.

To summarise then the position we have reached—a fertiliser must contain one or more of the three substances, nitrogen, phosphoric acid, and potash, which alone among the various elements necessary to the nutrition of the plant cannot be supplied by cultivated soils in amounts sufficient for profitable crop production. The soils do contain these substances in comparatively enormous quantities, but the distinguishing feature of a fertiliser which makes it effective when supplied in quantities comparable with those removed by the crop, is its "availability."

CHINESE IMITATIONS OF HARD STONES.

By W. L. Hillburgh.

Hard stones are imitated by the Chinese in three entirely different ways; by the use of glass, which is comparatively soft and easily scratched; by the treatment of a true hard stone to appear other than it really is; and by the use or treatment of a softer stone. Such imitations are frequently so cleverly imitated as to deceive even experts, Chinese as well as European, who, not having before come into contact with certain of them, fail to apply all the necessary tests.

Glass is used particularly for the reproduction of jade, white, green, or variegated, and sometimes so cleverly that even close optical inspection hardly suffices, and the specimen must be handled before its character is ascertainable. Many small objects are made of this imitation jade, principally thumb and finger rings, buttons, snuff bottles and their stoppers, and the like.

True jade has a certain waxy appearance, which is seldom seen in glass, and a greasy feel which glass lacks. It is harder than glass, and easily scratches it; in equal bulk it is heavier; and, like most hard stones, having a greater heat conductivity, feels colder at ordinary temperatures. Glass often contains minute bubbles in its interior, which appear as pin holes on its surface when ground.

A stone imitated in a very clever manner is agate, particularly the translucent brownish or greyish variety, in which dark brown spots and patches are included. Agate glass is frequently used for snuff bottles, and may generally be detected, without further test, by an examination of the bottom of the bottle, which, if of glass, usually shows several streaks approaching a point, an appearance not present in true agate. Another variety of agate or onyx, which is sometimes copied in conglomerate glass, for snuff bottles, consist of irregular masses and streaks of colour, indiscriminately mixed.

Ordinary crystal is imitated by a clear glass, and certain coloured and fissured varieties by coloured glasses. These fissured varieties are generally pink or blue, and are produced by crackling and re-heating the glass; their colour is in the body of the material, and not within the fissures, as in artificially coloured quartzes. Such glasses, and imitations of the valuable translucent green jade and other precious stones, are used particularly for the stoppers of snuff bottles.

In connection with these imitations, an ingenious application of glass to the culture of artificial pearls may be noted. Pearly white glass beads are placed between the body and the valves of the bivalve which produces the remarkable shells, in which nodules, fish, images, &c., are embedded. These beads become coated with nacre, and, upon removal from the shells, are pearls which do not require piercing; such as were to be obtained seemed of bad colour, and to have a tendency to lose their coatings about the mouths of the openings.

There are several kinds of artificially-treated stones. Quartz is coloured pink, to imitate rose quartz, and blue, the colour being applied, it is said, by boiling. The innumerable cracks take up the dye, so that, if well done, the whole appears to be uniformly tinted, until closely examined, when the colour is seen to lie in varying quantities in certain planes about transparent stone.* This material, which is classed by some Chinese with the glasses, and not with hard stones, is used principally for stoppers for snuff bottles and for jewellery, but also for the bottles themselves, and occasionally for ornamental pieces of considerable size, though it is somewhat unsuited for elaboration in these latter, on account of the weakness due to the numerous fissures.

Similar in nature are personal ornaments, principally bangles, of white quartz, stained green or brown in portions, and belt-hooks stained in a layer, to represent a variety of cameo.

Imitations oftentimes difficult of detection, and made with intent to defraud, are produced by "backing" thin crystal, as in a snuff-bottle, with

* Since Roman times methods of artificially colouring stones by boiling them in various liquids have been employed by European jewellers, whilst at present the manufacture of artificially coloured agates, is largely practised in Germany. The German agates, however, differ from the Chinese quartzes in that their colour is taken up by pores, not by figures, in the stones, and appear to be naturally and uniformly distributed. Much information on European methods of artificially staining stones is to be found in C. W. King's "Nat. Hist. Gems and Decorative Stones," and "Nat. Hist. Precious Stones, Metals, and Gems."

a transparent colour, making the ordinary crystal appear as a more valuable variety. A crystal snuff-bottle for example, is painted within with amethyst colour, which is then fixed so that it is difficult to remove. To all ordinary appearances the bottle is of amethyst, and, since crystal and amethyst differ only in their colouring, it answers the usual tests. If, however, such a bottle be held properly to the light, certain portions of it, notably the neck and bottom, or a design in relief, where reflections and refractions of the applied wash do not appear, show in their true colours. Generally the interior of the bottle is left unpolished, to give a hold for the wash, so that if the colour has been carelessly applied it shows, on close examination, in a number of very small points, like stippling. Smoky crystal and rose-tinted crystal are imitated in a like manner.

Small cavities in jade or quartz stones are sometimes so carefully filled with a waxy composition, of the proper colour, that the new surfaces appear to be those of imperfect portions of the original material. The filling substances becomes more noticeable when old, but can always be detected by optical examination, followed by testing with a pin point or a knife.

False cameos are occasionally made by fastening a piece of agate to an agate ground work of a different colour, the attached part being used to conceal a defect in, or an injury to, the material of the ground.

Objects of white jade are imitated in a white serpentine, which, though it takes neither the polish nor the rich lustre of true jade appears, when cut, sufficiently like the latter to be mistaken for it by the inexperienced and even by mineralogists. It is sometimes sold by unscrupulous persons as jade, but since it can be scratched with a knife is readily exposed.

Lapis lazuli is counterfeited by soapstone coloured blue by painting or (so it has been said) by staining. The execution of the painted specimens examined seemed to be very crude, and their material easily recognisable without the necessity of testing its hardness; they resembled rather genuine lapis lazuli which had been exposed to fire than the unburnt brilliant variety. According to King* the Chinese make imitations of large brightly-coloured agates by staining thin plates of alabaster.

* C. W. King, "Nat. Hist. Precious Stones, Metals, and Gems," Lond. 1865, p. 417.

THE TRADE OF INDIA, 1905-6.
III.

Customs Revenue.

The net revenue derived from Indian Customs duties in the year under review increased by 2·7 per cent. Eighteen of the articles on which duty is leviable yielded 82½ per cent. of the total revenue, and examination of the whole list shews that, although the Indian tariff comprises a lengthy tale of dutiable articles, there are comparatively only a few on which individually any revenue of importance is collected. These are spirits, grey piece goods (unbleached), sugar, piece goods (coloured), petroleum, white piece goods (bleached), silver and other metals, in the order named. On these the duties realised approached three-fourths of the above mentioned total.

The import rate of duty on cotton goods is 3½ per cent., *ad valorem*, and the total duty realised thereon in 1904-6 amounted to over 132 lakhs of rupees, or 26½ per cent. of the whole Customs revenue. On most classes of iron and steel the rate of duty is only 1 per cent. On nearly all other *ad valorem* dutiable articles the rate is 5 per cent.

The export tariff schedule is limited to rice and rice flour, and in these there was a fall of 12½ per cent., the decline corresponding of course with the decline in the exports of wheat. There is also what is called a tea cess, at the rate of a quarter of a pie, or the twelfth part of a farthing per pound on all tea the produce of India and exported abroad. The proceeds are paid to a committee to promote the consumption of Indian tea. The total collected in 1905-06 was over 3·11 lakhs of rupees.

Balance of Trade.

The excess of exports over imports, including treasure and Government transactions as well as merchandise, was 33½ lakhs of rupees, this being a very considerable increase over the figures six years ago. Some addition has to be made to this excess, in respect of unregistered trade, such as the goods conveyed away by native craft from the ports in the Native States on the west coast of India to Persia, Arabia, and Ceylon, as well as in respect of the value of the large re-exports of pearls from Bombay, mostly sent away by letter post. There is also a large excess of exports to be taken into account as regards the trade passing through the French Settlements, and a small and fluctuating amount in respect of the Portuguese Settlements. Mr. Noel Paton, however, reminds us that the exports of Government stores at the time of the South African war and the Somaliland expedition unduly swell the total exports from India, and that they are imperfectly recorded, seeing that there is no obligation on the part of the officials concerned in the export of those stores to pass them through the Customs.

Gold and Silver.

The value of the imports, exports, and net imports of gold and of silver present some curious features, and differ from the figures in the summary at the beginning of the report in that the former exclude and the latter include Government transactions in bullion.

Imported gold declined from 2,181 to 1,475 lakhs, while the exports increased from 1,210 to 1,429 lakhs of rupees. There was also production of gold of 358 lakhs worth within India itself. During the year there was a strong demand for gold in Japan and America, and this was contributed to by the

new arrangement under which gold destined for the Gold Reserve Fund or Gold Standard Fund is shipped directly from the country of production to London. Taking no account of what was mined in India the net imports of gold dropped from 970 to 45 lakhs, but adding the production the net addition to the stock of gold amounted to 404½ lakhs of rupees.

As to silver we are not informed in the report what was the value of the amount imported by Government but it must have been very large to have so considerably affected the net imports mentioned in the summary. The total imports of the metal slightly declined and the exports declined to 117 lakhs, a figure lower than that of any year since 1885-86. The net imports thus reached the entirely unprecedented total of 1572·3 lakhs.

Trade according to Countries and Shipping Trade.

Viewing the trade with countries for the year, the United Kingdom is of course first with 41·3, as against 41 8 per cent. in the previous year. Considering, though, the increasing facilities for direct shipment, the steadiness of the percentage seems to give cause for satisfaction. Next to the United Kingdom comes China, whose figures are of course largely affected by the exceptional circumstances of the opium trade. Germany takes the third place, her share of the trade having steadily increased from 9¾ lakhs' worth in 1902-3 to close on 20 lakhs in 1905-6. Then follow the United States, France, Japan, Belgium, and ten minor countries, Russia coming last of all.

We turn now to the important item of shipping. While the net increase in the value of imports and exports of merchandise in 1905-6 amounted to over £7,000,000 sterling, there was a decline in the tonnage of shipping entered and cleared at Indian ports, of about 9·25 per cent. The figures for 1904-05 were, however, abnormally large, and those of the later year indicate a return to the normal rate of progress. The steam tonnage was 97·4 of the total tonnage, and the average tonnage per steamer increased from 2,118 to 2,150 tons. These features are in strict accordance with the general laws, which are of course familiar to all students of shipping statistics. Viewing the figures from the point of nationality, it is significant to observe that, while English vessels enjoy an enormous preponderance, 81·3 per cent. of the total tonnage, they actually declined in number during the years 1905-06 from 5,683 to 4,938. On the other hand, the number of German vessels has been gradually and steadily creeping up from 270, in 1901-2, to 387 in 1905-6. After Germany follow Austria, Hungary, Norway, France, and Italy.

Frontier Trade.

The subject of Indian frontier trade is gradually coming to the front. It is a small matter naturally compared to the seaborne trade, but it displays steady progress, having increased by 177 per cent. since 1878-79.

The Quetta-Nushki Railway has now been opened, and it is reasonable to hope that with the greater facilities afforded by the daily service of trains since April last, trade will improve. There has been a steady, though small, increase in both imports and exports during the last five years. The chief imports from Seistan by this route consist of precious stones and pearls unset, while the exports were mainly cotton manufactures and indigo.

India's trade with Afghanistan, as a whole, has increased by 3 per cent. Fruit and nuts, animals (living), drugs and medicines, ghee, and raw wool follow in the order mentioned. There was an appreciable increase in the exports to Cabul, the principal articles being cotton piece goods, tea, cotton yarn, and manufactured leather. From Kandahar more than half the imports consists of raw wool, which rose from 18¾ to 23½ lakhs of rupees. Passing by Kashmir and Nepal, the trade with which calls for no special comment, we come to Tibet. The effect of the treaty of Lhassa of September, 1904, on the Indo-Tibetan trade has not yet been felt to any appreciable extent, although both imports (raw wool, borax, salt, horses, ponies, and mules) and exports (cotton piece goods and yarn, grain, coral, woollen manufactures, and metals) increased in about equal proportions. With Western China and Siam communications are as yet in too backward a condition to favour any marked development of trade.

C. E. D. Black.

NORWEGIAN CODFISH.

Codfish is caught in the winter and early spring on the northern and western coasts of Norway. When the boats and small steamers have entered harbour with their hauls, the entrails and heads are removed, and the fish, as a rule, sold to dealers, who take them on board vessels, or in packing houses close to the seashore. The fish is sold and bought by count, regardless of size. Expert splitters, placed at benches about two feet by five feet, and using a heavy, short, wide-bladed knife, make an incision along the lower or belly side, along the whole length of the fish, removing at the same time the upper half of the backbone. The fish is then, without washing, put down in even layers in the holds of vessels, or in packing houses, flesh side up. Over each layer is sprinkled salt, by an expert salter; the so called Trapani salt is preferred. Trapani salt is imported from Spain; it is a rather weak, small-grained, dull-coloured article, evaporated from sea water. About five barrels of this salt are used for every one thousand cod, and the net weight of each fish is about three and a-third pounds. The sizes of the fish vary greatly, and the salter has to use considerable judgment in the quantity of salt used. The American

Consul at Christiania says that when the desired number of fish, say 50,000 to 100,000, has been secured in one lot, the cargo is brought to some place where the rock formations, close to the seashore, are suitable for spreading such a large number for drying. As the cargo is unloaded, each fish is carefully washed in clean sea water. The black membranous skin on the insides of the fish is at the same time removed, likewise all blood contained in the bone cavities. Whenever the weather is suitable, clear windy weather being preferred, the fish is laid singly side by side on the flat rocks, and attended to by men, women, and even children. It is never exposed too long on the same side. Every two or three hours the fish are turned so that the flesh or lower side, and the upper skin-covered side, are alternately turned to the sun and wind. Every evening stacks are made of from fifty to one hundred fish, and the top covered with tarpaulins and weighted down with stones. In this manner the fish becomes solid and gains in appearance. In unfavourable weather, with fog and rain, it is left undisturbed in the stacks, but as soon as fine weather comes on it is again exposed. This is repeated till the fish is thoroughly cured and ready for shipment. The curing is done in the months of May and June, before warm weather sets in. It requires constant care and good judgment to bring the curing process to a satisfactory termination. If the fish is exposed too long to the sun it will scorch and turn dark; if there happens to be much foggy weather or rain its value will be much decreased by the influence of a certain fungus. To prevent this no remedy has as yet been discovered. Fish ready for export is either piled in the hold of ships in layers packed in bundles, each holding a certain weight, but of late years some of it is also shipped in tin-lined boxes when destined for a long voyage and warm climates. Codfish is also put up in Norway without the use of salt or any other preservative. Some of the fish is dried after simply removing the head and entrails. In this method, the fish are tied together by the tails in pairs, and hung on horizontal wooden poles resting on beams about eight feet above the ground. The fish preserved in this way are caught in Northern Norway during the regular fishing season, that is to say, from January to May. The article is known, in the trade, as stockfish, and is largely exported to Catholic countries. By ancient custom, this kind of fish is never taken down for shipment before June 12th each year; sometimes later, if the weather has been unfavourable. Cod and other fish is also air-dried the whole year round, after having first been split open the whole length, the only junction between the two halves being the tails and about an inch of fish above it. By the cut, the whole of the backbone is left on one side of the fish when split. Each fish is then strung on poles for drying in the same manner as the round, or stockfish. Among the fish prepared in the latter manner are cod, ling, coalfish, torsk, and some other varieties.

HOME INDUSTRIES.

Irish Railways.—It is generally believed to be the intention of the present Government to bring in a Bill for the purchase of the Irish railways; and the evidence taken by the Commission on Irish Railways, now sitting strengthens the preconceived opinion that without some sort of unification substantial modification of rates, and general acceleration of transit, are not possible. It is often said that railway rates are higher in Ireland than in other parts of the United Kingdom, and that the managers of the Irish railways treat the public badly, but this would not appear to be borne out by the facts. It is, of course, true that Ireland suffers from a multiplicity of railway companies, which means much unnecessary expenditure, but whilst the net receipts are much lower in Ireland than in Great Britain, and the costs of management much higher, yet, owing to the much smaller cost of construction, the average dividend from Irish railways is higher than in England or Scotland. And even the proportion of expenditure to receipts is lower than in England or Wales, though somewhat higher than in Scotland. Nor would it be true to say that, anyway of late years, the leading Irish railways have shrunk from large expenditure in opening up the country to tourist traffic, or to deny that they are co-operating in the general endeavour to improve the agricultural industries, by putting into operation schemes beneficial to the producer and trader. This has been admitted by official witnesses giving evidence before the Railway Commission, Mr. Robert Cantrell, for example, the representative of the Department of Agriculture and Technical Instruction, saying that the companies had readily adopted, as far as legally possible, the many proposals emanating from the department in connection with transit matters. As to opening up the country to the tourist the Irish railways, many of them, have of late, been exceptionally enterprising. The northern railways offer special facilities for transit to Carlingford Lough, the Giant's Causeway, and Portrush; the Dublin, Wicklow and Wexford exploit the Wicklow scenery; the Midland Great Western carry large numbers to Achill and the district about Recess; whilst the Great Southern and Western have special services to Killarney, and besides offering cheap fares, the companies have, of late, built a number of hotels where the accommodation was previously bad or insufficient. But if it be true, as it is, that the Irish railways are doing all that the yare legally entitled to do, it is equally true that they are doing less than the circumstances of the country require. Such service will only be possible under a practical scheme of unification which would permit of the railways being worked on economical principles. The Government that brought about this change would be conferring an immense benefit upon the languishing industries of Ireland, and it may be hoped that the recommendations of the Railway Commission will do something towards this end.

The Demand for Pig Iron.—In November, 1905, the total exports of pig iron from the United Kingdom amounted to 82,719 tons; in the same month of the present year they reached 182,046 tons. The increased demand has been general all over the Continent with the exception of Sweden, which last month took only 3,903 tons, as compared with 5,112 tons in November, 1905; but by far the greatest increase has been in the exports to Germany and the United States, the figures for the former country being 38,861 tons as compared with 15,952 tons in the corresponding month of last year, and for the latter 52,579 tons, as against only 11,179 tons in November, 1905. In the eleven months ended November, the exports of pig iron from the United Kingdom amounted to 581,233 tons, more than for the corresponding months of last year, but only 86,000 tons of it has been due to America. It is only very recently that the American demand has been considerable. The larger increase has been in German imports, due to the inability of Germany to supply her neighbours with German iron. Notwithstanding her furnace capacity, and her large employment of the basic process, Germany cannot supply the wants of her own steel makers. Both Germany and the United States have been compelled to come to the United Kingdom for hematite as well as for ordinary iron, and there is no likelihood of an early cessation of the demand. Home contracts for raw material are drawing to an end, and the tendency of prices is still upwards. The prices of finished product are advancing also, although the makers of shipbuilding materials are restrained by the depressed condition of the consuming industry. In the North the export demand has become so excessive that small smelters will soon be compelled to refuse all further foreign business unless they are willing to see their home customers stranded for want of raw material. It would be rash to attempt to predict when the demand from Germany and the United States, more especially the latter, will slacken. Meanwhile, to quote the *Statist*, the only reserve of iron in Europe seems to be the stock of 540,000 tons in the Middlesborough Warrant Stores, and nobody knows who actually holds that stock. It would be more satisfactory if the abnormal demand came from home requirements rather than the needs of Germany and the United States, assisted in much smaller degree, but still appreciably, by the increasing demands of Italy, Japan, and Canada, the export to Italy last month having risen—as compared with November, 1905—from 4,878 tons to 10,597 tons; to Japan from 2,789 tons to 6,549 tons; and to Canada from 5,893 tons to 15,754 tons.

The Working of the Coal Tax.—A Parliamentary paper, just issued, shows the extent to which the Exchequer benefited from the imposition of the coal tax, now repealed. The duty came into force in the middle of April, 1901, and ceased at the end of October last. Between these dates, 361,577,500 tons of coal were exported, of which 92,683,300 tons were bunker coal. The proportion of this export liable to duty was 223,066,900 tons, say 62 per cent., and the amount of tax collected was £11,125,100. The smallest sum received was in the initial period of 1901-2, when the rebates amounted to a considerable sum. The receipts from the tax were highest in 1905-6, when the tax yielded £2,184,000. The average for the five years works out at £1,934,400. The duty paid during the current year was £1,533,200, equivalent to £2,628,000 for the twelve months. It will be seen from these figures that the duty brought in a very considerable sum to the Exchequer. Opinions as to its effect upon the coal industry differ sharply, but it is certain that the German coal export trade benefited by it.

British Preference in Canada.—Some uneasiness has been caused by the tariff changes proposed by the Dominion Government. So far as the general tariff is concerned, British exporters do not complain. The new tariff abolishes the rigid 33⅓ preference in favour of British goods, and substitutes a more varied classification. The Canadian official view is that upon the whole the new schedule is slightly more favourable to Great Britain than the old one. The uneasiness is due to what is called the Intermediate Tariff, a new device which is intended to assist the Dominion Government in negotiating for reciprocity with protectionist countries, and averages 10 per cent. lower than the general tariff. Obviously if this Intermediate Tariff is to be applied, it may materially modify the preferential position of Great Britain; and assuming it is applied to imports from the United States, may have very wide reaching results. But if the view of the Dominion Minister of Marine is the correct one, and is adopted by the Legislature and the Government, this Intermediate Tariff will be inoperative in the direction from which there is the greatest danger. Mr. Fielding says that the Intermediate Tariff cannot apply to the United States, because it is governed by such favoured nation treaties as are binding on Canada, and as the United States does not enter into such arrangements, the Intermediate Tarift cannot be applied to it. The same argument would exclude Germany, whose trade with the Dominion at present is not very considerable, but which, under altered conditions, might grow to much larger dimensions. The most-favoured nation treaties in force are with countries from which Great Britain has little to fear. This official view is not generally accepted in Canada, where, rightly or wrongly, it is thought that the Intermediate Tariff is designed mainly as a basis for negotiation with the United States. That the export trade of the United States with Canada grows more rapidly than the British, notwithstanding the present preferential tariff in favour of the latter, is shown in the following figures, taken from the official monthly report of the Department of Trade and Commerce of Canada, just to hand:—

	Imports from Great Britain. Dols.	Imports from United States. Dols.
1904	25,934,295	72,218,401
1905	27,847,699	70,097,293
1906	32,745,296	83,420,899

These figures are for the five months ended August 31, 1906, and show that while in the three years the increase of British exports to Canada has been between 6,000,000 and 7,000,000 dollars, those from the United States have increased by over eleven million dollars.

Cornish Mines.— Attention was directed some time ago in these Notes to the revival of the Cornish mining industry, and since then there have been further and considerable developments. There would seem to be no sufficient reason why Cornwall should not again become a great ore-producing county. A century ago, the Cornish annual output of copper was worth roughly one and a quarter million sterling, and it must be remembered that the output of copper ceased not because there was no more copper to be got, but because prices fell to a level, that prevented its profitable extraction. In the palmy days of the industry, the price of copper was about £140 per ton, then it fell to £100, and afterwards to a much lower figure. Attention was then turned to tin, and there was a similar experience, and when tin fell to something like £30 per ton few of the mines were able to continue working at a profit. But now prices have gone up again to the profitable level, and are likely to continue there. Moreover, an improved system of working will largely reduce expenses. There are of course difficulties in the way of re-opening many of the mines, the most serious being the unwatering, but they are not insuperable, or, perhaps, very formidable, while the abolition of the cost book system, the use of up-to-date machinery, the establishment of smelting works at the mines themselves, and the general adoption of modern methods, cannot fail to reduce working expenses, and go far to ensure a renewed period of prosperity for copper and tin mining in Cornwall.

GENERAL NOTES.

ST. PIERRE AND MIQUÉLON.—In reporting upon the North American colonies of France, Mr. Consul Woodhouse points out the desirability of direct and regular communication between the islands of Newfoundland. At present the only mail and passenger service that exists is maintained by a small passenger steamer, under the French flag, which makes a round to North Sydney, Halifax, and back again once a fortnight. There is no direct means of communication, although the Newfoundland coastal mail steamers plying between St. John's and Port-aux-Basques pass by St. Pierre every trip. The French authorities, says Mr. Woodhouse, would willingly waive all harbour and light dues, pay for transport of mails, and grant all the facilities in their power, if the steamers would call regularly. Newfoundland would benefit by securing a market for its produce, and St. Pierre by obtaining the ordinary necessities of life at lower rates. Unfortunately, the French islands are suffering much from bad fishing seasons, only about half the number of schooners being fitted out last season as compared with that of 1902, and the two islands are entirely dependent on the fisheries.

UNITED STATES CEMENT COMBINATION.—In a recent report issued by the United States Department of Commerce and Labour, it is stated that a bulletin of the Geographical Survey calls attention to the fact that there is a noticeable concentration of interests in the cement industry, and that this will probably become more accentuated year by year. The 88 plants in existence in 1905 were owned by 78 companies, and several of these nominally independent companies are closely connected by ownership. It is stated, however, that good raw materials are so widely distributed in the United States that there is hardly a county which could not produce Portland cement if prices were forced high enough. The only limitation now on the erection of cement plants is in the fact that the great cost makes the venture prohibitive for the individual or the small firm. The cement industry is at present in a more concentrated condition than was the iron and steel industry at the date of the formation of the United States Steel Corporation. The total authorised capital of all the American Portland cement companies now in operation will fall between the limits of £22,000,000 and £25,000,000. The bulletin states that this capitalisation cannot be considered excessive in view of the fact that it would cost probably from £15,000,000 to £17,000,000 to replace the plants now in existence.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 16, 1907.—Adjourned Discussion on Mr. J. W. GORDON's paper, on "Patent-law Reform." SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

JANUARY 23.—"The Isthmus of Panama." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company. SIR JOHN WOLFE-BARRY, K.C.B., F.R.S., will preside.

JANUARY 30.— "Apprenticeship." By JAMES PARSONS, M.A. SIR WILLIAM BOUSFIELD, M.A., LL.D. will preside.

Dates to be hereafter announced:—

"The Principles and Practice of Insurance, and their modern Developments." By THOMAS EMLEY YOUNG, B.A., Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association.

"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Engraving and Photogravure." By. J. CRAIG ANNAN.

"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

"Cold Storage and Food Supply." By HAL WILLIAMS.

"Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts.

"Motor Omnibuses." By LORD MONTAGU OF BEAULIEU.

"The Discovery of the South Eastern Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S.

"Hungarian Arts, Home Home Industries and Commerce." By LOUIS FELBERMAN.

"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

JANUARY 24.—"The Bhils of Western India." By CAPTAIN E. BARNES, Indian Political Department. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

FEBRUARY 14.—"The Practical Side of Famine in India." By SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., late Chief Commissioner of the Central Provinces.

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I.. LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

JANUARY 15.—"The Progress of the Uganda Protectorate." By GEORGE WILSON, C.B., Deputy Commissioner Uganda Protectorate. Brigadier-General SIR FREDERICK J. D. LUGARD, K.C.M.G., C.B., D.S.O., will preside.

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

JANUARY 29.—"Artistic Treatment of the Exterior of the Pianoforte." By WILLIAM DALE, F.S.A. T. G. JACKSON, R.A., will preside.

FEBRUARY 19.—"Joinery and Furniture Making." By A. ROMNEY GREEN.

MARCH 19. —"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

January 28; February 4, 11.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S, "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

JUVENILE LECTURES.

Wednesday afternoons, January 2 and 9, 1907, at 5 o'clock.

"Perils and Adventures Underground." By BENNETT H. BROUGH.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, DEC. 31...London Institution, Finsbury-circus, E.C., 4 p.m (Juvenile Lecture.) Mr. W. H. Garrison, "Volcanoes."

TUESDAY, JAN. 1..Royal Institution, Albemarle-street, W. 3 p.m. (Juvenile Lecture.) Mr. W. Duddell, "Signalling to a Distance—from Primitive Man to Radio-telegraphy." (Lecture III.)

WEDNESDAY, JAN. 2. SOCIETY OF ARTS, John-street, Adelphi, 5 p.m. (Juvenile Lecture.) Mr. Bennett Brough, "Perils and Adventures Underground." (Lecture I.)

London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Mr. W. H. Garrison, "The Fire Belt around the Globe."

THURSDAY, JAN. 3—Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Mr. W. Duddell, "Signalling to a Distance." (Lecture IV.)

FRIDAY, JAN. 4...London Institution, Finsbury-circus, E.C., 4 p.m. (Juvenile Lecture.) Mr. H. Garrison, "Earthquakes and Geysers."

SATURDAY, JAN. 5..Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Mr. W. Duddell, "Signalling from a Distance." (Lecture V.)

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FRIDAY, JANUARY 4, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 9, 5 p.m. (Juvenile Lectures.) BENNETT H. BROUGH, "Perils and Adventures Underground." (Lecture II.)

Members requiring a ticket for this lecture should apply at once.

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

On Wednesday evening, January 2nd, Mr. Bennett H. Brough delivered the first lecture of his course, addressed to a juvenile audience, on "Perils and Adventures Underground." The lecturer dealt first with the importance of the subject in view of the enormous number of our countrymen engaged in mining work and the vast amount of British capital invested in the industry. In this country alone the value of the minerals raised annually was close upon a hundred million pounds, the results of the labour of nearly a million persons directly employed in their extraction.

The old story-tellers whose fancy peopled the earth with giants and dragons, the air with fairies and witches on broomsticks, and the waters with mermaids, created the gnomes to be the guardians of underground treasures. But science, which fought against ignorance in the earth above, had descended to the depths below, and had dashed the sceptre from the hands of the gnome king. Nowadays, although the miner did not suffer from the evil powers of the gnomes of fairy mythology, or even of "demons in the form of little black boys," said to have been seen by an English traveller in Hungarian mines, he had to face danger on all sides. The elements—earth, air, fire and water—all conspired against him. Earth threatened him with falls of rock, air when it was mixed with poisonous gases, fire when he was blasting rock with explosives, and water with inundations. This constant exposure to danger had given miners wonderful quickness in dealing with emergencies, and great bravery in facing perils; and their heroic conduct in trying to rescue comrades had never been surpassed on any field of battle.

Investors would agree that mining was, at best, a very risky business; and examples were given of the part that chance had played in the discovery of mineral treasures, the stories being told of the discovery of gold in California, of tellurium ore in Colorado, of coal in Saxony, of diamonds at Kimberley, of the Comstock lode in Nevada, of the Klondyke goldfields, and of the old Spanish workings at the Darien gold mine in Colombia.

The various operations of mining were described, and the dangers against which the miner had to contend were enumerated. The principal source of accidents was due to falls of roof; and the need for carefully fixing timber props was urged. Accidents in lowering men down shafts were described, and reference was made to the terrible catastrophe on October 9th last at the Simmer and Jack East gold mine, when owing to the breaking of the steel winding rope, 23 Chinese miners were dashed to the bottom of the shaft, 1,200 feet below. In order to safeguard against such accidents, safety-catches had been invented, and their construction was explained by the aid of models. The dangers attaching to the use of explosives were pointed out, and the advantages to be gained from the use of electric firing machines, and of bobbinite and other flameless explosives were practically shown. Accidents in haulage operations and in the use of machinery underground received attention, and the continuous improvement in mining conditions since the Royal Commission of 1842, which led to the prohibition of the employment underground of women and of boys under ten years of age, was traced.

In illustration of the lecture, porcelain figures of gnomes were lent by E. Wahliss, 88, Oxford-street, W., electric blasting apparatus by John Davis and Son, Ltd., Derby, explosives by Curtis and Harvey, Ltd., 3, Gracechurch-street, E.C., and models and diagrams by the Board of Education.

The second lecture will be delivered on Wednesday next, 9th inst., at 5 p.m.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ARTIFICIAL FERTILISERS: THEIR NATURE AND FUNCTION.

By A. D. Hall, M.A.,
Director of the Rothamsted Experimental Station, Lawes Agricultural Trust.

Lecture II.—Delivered November 26.

The Supply of Nitrogen to the Plant.

In taking up the detailed study of fertilisers it is natural to begin with those containing nitrogen: not only is it the most important fertilising element, for it both costs more per pound and returns more to the farmer for his investment than either phosphoric acid or potash, but also it differs from the others in that plants live habitually in contact with a vast unusable store of it. Since plants live in an atmosphere four-fifths of which consists of elementary nitrogen it is perhaps necessary to justify a little the statement made in my first lecture that they only obtain the nitrogen they require in a combined form by means of their roots. The form that the demonstration has taken may be seen in the water culture experiment which has already been illustrated; in the absence of combined nitrogen the development of the plant is very small. The same is true for cultures in sand, which are more comparable with natural conditions, and many experiments have been performed with the greatest care with plants thus growing in artificial soils supplied with a known amount of nitrogen. When the plants have come to the full term of their growth the nitrogen they contain is found to be exactly balanced by the amount of the same element which has been removed from the soil. And if objection be made that such plants are enfeebled by the unnatural conditions, so that they have lost their power to bring nitrogen into combination —to "fix" it, in current language—there are many other types of experiment which render such criticism invalid. For example, Hellriegel performed a long series of experiments with different plants which showed, up to a point, that the amount of growth was very closely proportional to the amount of nitrogen supplied in a combined form when there was a sufficiency of the other elements of plant food present. This would not be the case were the plant able to get any nitrogen for itself from the atmosphere. Again, to meet an early objection of Liebig and his followers, in the Rothamsted experiments upon leafy root crops, which still seemed unable to draw upon the nitrogen of the air though freely supplied with phosphoric acid and potash, to one plot there was supplied a very small amount of active nitrogenous manure, just to give the young plant a good start, whereupon it might be able to continue to feed upon the atmospheric nitrogen. But, as Table VIII. shows, the small addition of nitrogen only produced a small increase of crop, very fairly proportional to the much larger increase produced by a normal application of the same fertiliser.

TABLE VII.—Barley (Hellriegel and Wilfarth).

Nitrogen Supplied.	Dry Matter Produced.
0	0·51
0·028	3·0
0·056	5·6
0·112	10·8
0·336	29·3

TABLE VIII.—Rothamsted Mangels (1876-1902).

	Roots per Acre.	Increase per lb. of N.
	Tons.	Tons.
Superphosphate, and Sulphate of Potash	4·55	
Ditto. + 7·8 lb. N.	5·93	0·17
Ditto. + 86 „	14·03	0·11
Ditto. + 93·8 „	14·60	0·107

If then the yield of most of our field crops is, within the limits of experimental error, proportional to the amount of combined nitrogen they receive, it is necessary to conclude that they have drawn none from the atmosphere. The tenacity with which in the face of such evidence the opinion has been held that the leaf of the plant can obtain nitrogen as well as carbon from the atmosphere is due to the difficulty that is thus introduced of explaining how the world's original stock of combined nitrogen can have arisen. Assuming the

world to have cooled down from the state of incandescent gas, it must have started with all its nitrogen in the free gaseous state, yet as we see it to-day all the stock of combined nitrogen is of organic origin.

The circulatory process through which combined nitrogen is put is very plain. Animals can only use the highly organised compounds like the proteids; these they break down during their vital processes to simpler compounds like urea and the amides, which in turn are taken by plants to be built up once more into the proteid complexes. This is, however, only a circulation, subject to occasional losses by breakings down as far as elementary nitrogen; there is never any bringing of fresh elementary nitrogen into the account. The stocks of combined nitrogen that have been handed down from past ages all speak of the same organic circulation, never of fixation. Coal is but the *débris* of an extinct vegetation; nitrate of soda, the glorified result of the same decay processes which give rise to nitrate of potash in India and nitrate of lime in the old nitre beds. Virgin soils with their vast stores of nitrogenous humus are often looked upon as having gained nitrogen by the accumulation of long epochs of vegetable growth, but if plants cannot fix nitrogen there can have been no gain but only a circulation of the pre-existing combined stock. At first sight there seem no processes at work either to bring about the original combination or to repair the stock from time to time. Inorganic agencies are certainly trifling because nitrogen is a difficult element to bring into combination, so great an initial expenditure of energy is required to separate the atoms in the gaseous molecule. Electric sparks will bring about a combination of nitrogen and oxygen, and lightning flashes through the air have been invoked to account for the trace of nitric acid to be found in the atmosphere and in rain water. Such an origin, however, is still doubtful, for it has not been found possible to correlate variations in the nitric acid content of the rain with the frequency or otherwise of thunderstorms. Again, it has been supposed that during the evaporation of water there is always a slight combination of nitrogen with the elements of water to form ammonium nitrite, but more recent and refined experiments are against the existence of any such reaction.

There has, however, of late years been discovered one vital process capable of fixing nitrogen, which has probably been operative since the beginning of life on the earth, and this process is the property of certain groups of bacteria only. The history of nitrogen-fixing bacteria begins some thirty years ago with the resolution by Hellriegel and Wilfarth of the great outstanding difficulty in the theory that plants only make use of combined nitrogen. Though the demonstration in the laboratory of this opinion seemed perfect, and though in the main it was corroborated by field experiments, there was one group of plants—peas, beans, clover, and their allies—which seemed to derive little or no benefit from nitrogenous fertilisers and yet actually left the land richer in nitrogen after their growth, although in the crop removed there was an exceptional amount of nitrogen. That beans or vetches or lupins were the best preparation for a wheat crop was a commonplace of Roman agriculture, and the same observation became afterwards enshrined in that most fundamental of rotations, the Norfolk four-course system, in which wheat follows clover or beans. Hellriegel and Wilfarth found that leguminous plants did gather nitrogen from the atmosphere, and could, therefore, become wholly independent of nitrogenous manures; but this only took place when, by infection from the soil, certain characteristic nodules were formed upon the roots. These nodules were found to be colonies of a particular bacterium which seem to live symbiotically on the host plant, furnishing it with nitrogenous matter and deriving from it the carbohydate required for the fixation of nitrogen. As the fixation of nitrogen is a chemical process analogous to going up hill it requires a supply of energy from outside, which external source of energy the bacterium obtains by the oxidation of carbohydate in some form or other. The particular bacterium living in symbiosis with the leguminous plants seems to be highly specialised and has not been transferred to other non-leguminous plants; only with some difficulty it has been made to grow and to fix nitrogen when living alone and no longer in association with its host. With increasing knowledge of the methods of handling this organism, it seems probable that by cultivation we shall be able to obtain races showing variations in their power of fixing nitrogen, but how long they will retain this greater or lesser virulence after inoculation back to the leguminous plant is still uncertain.

The leguminous plants form then by their association with nitrogen-fixing bacteria, one considerable natural source of combined

nitrogen, and how effective they can be in accumulating fertilising matter in the soil may be judged from the accompanying Table showing the results of some of the Rothamsted experiments upon leguminous crops.

The only practical limitation to the gathering of nitrogen by this method lies in the difficulty that is found in growing leguminous crops frequently on the same land. Although, as we have seen, it is possible to grow wheat year after year for more than half a century and maintain the yield if the appropriate manures are employed, on few soils can clover be grown with success more frequently than once in four and even once in seven years. As the farmer says, the land becomes "clover sick," and though the clover seed germinates and grows for a time the constitution of the plant is so weak, that it almost inevitably succumbs during the winter to an attack of fungoid or other disease. The determining cause of this weakness of constitution which lies at the back of "clover sickness" is still unknown, but preventing as it does the more extended use of these nitrogen collecting crops it would be of serious economic importance to find the cause and a remedy.

More recently, however, other bacteria have been discovered in the soil which are capable of fixing free atmospheric nitrogen without association with any host plant, provided they are supplied with some carbohydrate, from the oxidation of which they derive the energy necessary to bring the nitrogen into combination. Of these bacteria the best known and probably the most effective is a large organism, first examined by Beijerinck in Holland, and called by him *Azotobacter chroococcum.* It is widely distributed in cultivated soils both in Europe and America, and although I failed to detect it in the arid soils from the high veldt or the Karoo in South Africa, yet I obtained similar though perhaps slightly varying bacteria from cultivated soils in tropical East Africa and in Egypt. It appears to be only active when there is some calcium carbonate in the soil, possibly because in its oxidising reaction certain acids are produced which must be neutralised before its activity will continue. Roughly speaking, its action is to oxidise carbohydrates to carbon dioxide and water, forming as bye-products certain organic acids, *e.g.*, butyric, and some dark brown humus (whence the name "chroococcum"), and incidentally bringing a certain amount of nitrogen into combination, not more, however, under the most favourable laboratory conditions than 1 to 2 per cent. of the carbohydrate consumed. It is, however, extremely probable that we may look to this organism and its allies as the origin of the continued accumulation of nitrogen in such rich virgin soils as the black soils of the Russian Steppes or of Manitoba. As long as these lands were uncultivated the annual fall of the leaf and dying down of the summer vegetation furnished the conditions necessary for the activity of the *azotobacter*. The carbohydate - containing material thus returned to the soil provides the organism with its necessary food supply by the oxidation of which it gains energy to fix the atmospheric nitrogen. In cultivated soils where the crop is removed the action is almost brought to a standstill, as may be seen in the steady loss of nitrogen from the arable soils at Rothamsted during the fifty years they have been cropped without any extraneous nitrogen supply. Only when land is laid down to grass is there a sufficient amount of carbohydate *débris* returned to the soil to allow of the gain of enough nitrogen to be evident in practice. A good example of the natural accumulation of combined nitrogen may be seen in two pieces of land at Rothamsted, which for the last twenty-five years have been allowed to run wild and assume a natural prairie condition of self-sown weeds and grasses that are never taken away but left to rot where they died down. Samples of the soil had been taken at the beginning of the period, and by

TABLE IX.

Manuring for Swede crop only.	Clover, 1894.	Wheat, 1895.			Roots, 1896.			Barley, 1897.		
		After fallow.	After clover.	Increase due to clover.	After fallow.	After clover.	Increase due to clover.	After fallow.	After clover.	Increase due to clover.
	cwt.	lb.	lb.	Per cent.	cwt.	cwt.	Per cent.	lb.	lb.	Per cent.
Mineral manure ..	59·7	4,220	5,180	+ 22·7	179·1	244·5	+ 36·5	2,103	3,991	+ 89·8
Complete manure	76·7	4,547	5,209	+ 14.6	379·8	388·8	+ 2·4	3,595	4,913	+ 36·7

comparing them with more recently taken samples it has been possible to detect a very considerabe fixation of nitrogen, amounting in the most favourable case to nearly one hundred pounds of nitrogen per acre per annum.

The second similar piece of land shows a much lower result and this is correlated with the absence of carbonate of lime in the soil of that plot and a corresponding absence of the *azotobacter* organism.

It is too early yet to speculate freely on the work of the various nitrogen-fixing bacteria; we may, however, confidently attribute to their action both the current stock of combined nitrogen in the world and the main source of its renewal in the future.

Attempts have already been made to raise these nitrogen-fixing bacteria artificially, particularly those associated with leguminous plants, and by introducing them into soil that was lacking or poorly supplied with them, to render it capable of self-enrichment in this most natural manner. Such cultures are, in fact, sold commercially at the present time and have in some cases been somewhat unscrupulously boomed as dispensing with the need for nitrogenous fertilisers. Undoubtedly cases may be quoted where the use of these pure cultures of nodule-forming bacteria has been of great service, generally on newly-reclaimed soils which have thus become for the first time capable of carrying a legumiuous crop. But in old cultivated soils the organism is already present, and sufficient evidence is not yet forthcoming to show that the new introductions have had any effect; certainly the results obtained in the British Isles are almost wholly negative. Doubtless, the useful soil bacteria will be domesticated, improved, and made more effective just as our flocks and herds have been tamed and developed, while the useless ones will be stamped out as vermin; but at the present time we cannot be satisfied that any improved race of bacteria introduced artificially into the soil has managed to persist and get a real footing in face of the competition of the enormous natural bacterial flora already existing there. So the picture of the farmer carrying the manure for a field in his waistcoat pocket and applying it with a hypodermic syringe, is still a vision of the future.

These natural processes for the recuperation of our stock of combined nitrogen have, during the last year or two, been supplemented by one or two manufacturing processes of great interest in themselves, which are on the point of becoming factors of importance in the fertiliser market.

Speaking broadly, there are two ways of bringing free nitrogen gas into combination; first, at extremely high temperatures, such as are attained in the electric arc or sparks, nitrogen will combine with oxygen to form various oxides from which with water, nitric acid will eventually result; secondly, nitrogen will combine with a few metals and allied bodies, again at high temperatures, to yield substances which under the action of water yield ammonia. It is this latter method which was first developed on a commercial scale by Professor Frank and Dr. Caro in Berlin. They did not exactly start with a metal but with calcium carbide, the substance now so well known as the source of acetylene for illumination. This body Frank and Caro found would combine readily with nitrogen gas at quite moderate temperatures, and the resulting substance, calcium cyanamide as it is called, or kalkstickstoff, will decompose under the action of water, yielding its nitrogen as ammonia and the calcium and carbon as calcium carbonate. In the manufacturing process the calcium carbide is first roughly ground and then heated in iron tubes through which a current of nitrogen gas is passed. The calcium carbide, which itself results from the reaction of a mixture of chalk and coke in the electric furnace, must either be purchased or manufactured by a preliminary process. The two reactions of forming the carbide and uniting it with nitrogen can indeed be carried out simultaneously, but this method has been abandoned in practice. The Italian company, which has now taken up the patents for the manufacture of calcium cyanamide, has established its factory alongside one of the great producers of calcium carbide at Piano d'Orte in the hills above Rome, where water-power can be obtained for the cheap generation of electricity. On theoretical grounds one electrical horse-power per annum should bring about the fixation of 772 kilogrammes of nitrogen, in practice 300-330 have been attained. The nitrogen gas is obtained by passing a current of air over red-hot copper, the copper oxide formed being afterwards reduced to the metallic state again by sending over it a current of coal-gas while it is still hot. More recently a process of obtaining nitrogen by frictional distillation from liquefied air has been employed. The resulting calcium cyanamide is a dark grey, heavy powder, slowly reacting with the moisture in the air and giving off certain

strongly smelling gases characteristic of calcium carbide itself. The normal product contains as much as 20 per cent. of nitrogen, the theoretical substance being $CaCN_2$ with 35 per cent. of nitrogen. With superheated steam it reacts to produce ammonia and calcium carbonates in accordance with the equation—

$$CaCN_2 + 3\ H_2O = 2NH_3 + 3\ CaCO_3.$$

With acids the reaction is rather violent and various highly nitrogenous bodies are produced. It is the first reaction, however, which is supposed to take place when calcium cyanamide is applied to the soil: it should change slowly into ammonia, which will be arrested by the soil, and calcium carbonate. It has been shown, however, by Löhnis, that the reaction with water alone is slow and not particularly effective, but that certain soil bacteria are operative and bring about the change in practice. Löhnis's conclusions have been confirmed in the Rothamsted Laboratory, and it is certainly a remarkable fact that bacteria present in the soil should be capable of attacking so entirely novel a material. As a commercial fertiliser, calcium cyanamide has been subjected to a series of fairly conclusive trials which would show that on most soils it is not quite so effective as sulphate of ammonia supplying an equal amount of nitrogen. For example Table X shows the results of four

TABLE X.—ROTHAMSTED EXPERIMENTS WITH CALCIUM CYANAMIDE, 1905.

	Barley.		Mangels.		
	Grain.	Straw.			
	Bushels	Cwt.	Tons.	Tons.	Tons.
Calcium cyanamide	34·3	19	22·0	11·1	28·9
Sulphate of ammonia	37·5	24	23·5	10·0	27·9

trials at Rothamsted in 1905, mangels and barley being the crops under experiment. On soils poor in lime doubtless the cyanamide would give comparatively better results because then the carbonate of lime, which is the bye-product of the decomposition taking place in the soil, would itself be of considerable value. The Rothamsted soil, however, contains sufficient carbonate of lime to minimise the effect of this factor. The chief drawback to the practical employment of calcium cyanamide as a manure is its chemical activity and sensitiveness to the action of water. It must travel in air-tight drums, as it not only deteriorates in damp air but generates gases, some of which are dangerous and inflammable. It cannot be mixed with other manures; a mixture with superphosphate, in particular, gets unpleasantly hot, even on a small scale. It has, therefore, to be sown on the land alone, and it should be incorporated with the soil a week or two before any seed is sown. If left on the surface there will be loss of ammonia, and even in the soil the ammonia and other gases evolved at first are injurious to the germination of seed. For similar reasons it cannot be used as a top dressing. These difficulties in handling the material are likely to prove serious drawbacks to its use by the ordinary farmer, and it is a question whether it would not be wise for the manufacturers to push the process a stage further and actually turn out an ammonia compound. For example, it is probable that calcium cyanamide could easily be made to react with superphosphate to produce a double phosphate of calcium and ammonium, which would be a valuable manure of a type that farmers are familiar with, miscible also with nearly all other fertilisers.

The other method of bringing nitrogen into combination—that of effecting its union with oxygen at the temperature of the electric arc—has received considerable attention, and forms the base of at least two working processes. It will be remembered that when Sir William Crookes in 1898, in his British Association address, warned the world of the rapidly progressive exhaustion of its supplies of combined nitrogen, it was to the union of nitrogen with oxygen that he looked for the future supply of combined nitrogen for the wheat crop, and he showed experimentally how the two gases would burn together at a very high temperature. Not enough heat, however, is given out by the flame to bring more gas up to the ignition point, hence the flame is only continuous as long as external energy is poured in. The reaction which takes place is expressed by the equation—

$$N + O = NO - 21{\cdot}6\ K.$$

Energy to the extent of 21·6 Kalories are required to bring 14 grams of nitrogen into combination.

Calculating from the best results Lord Rayleigh had obtained in bringing nitrogen and oxygen into combination by the electric spark, Crookes decided that if electricity could be obtained at 1-17th of a penny per

Board of Trade unit, as it was expected would be the case at Niagara, then nitrate of soda could be made artificially at about £5 per ton.

Such an electrical process was installed at Niagara by Bradley and Lovejoy, who produced a number of arcs between platinum poles with a continuous current at a potential of 10,000 volts. The oxides of nitrogen generated were converted into nitric and nitrous acids by steam and more oxygen, and a mixture of sodium nitrite and nitrate was prepared for agricultural purposes. The installation, however, only ran for 15 months, for though considerable amounts of nitric acid were produced, technical difficulties in maintaining the apparatus in working order proved insuperable. More recently what promises to be a really working process has been devised by Professor Berkeland and is running on a commercial scale at Notodden in Norway. In the Berkeland-Eyde process an alternating current at about 5,000 volts is set to form an arc between U-shaped copper electrodes, which are hollow and kept cool by a current of water within. The electrodes are placed equatorially between the poles of a powerful electro-magnet which has the effect of causing the arc to spread out into a broad flat flame. Though the temperature of the arc-flame is calculated to be 2600° C. it is not particularly luminous; it may be looked at directly from a yard's distance.

Through the furnace in which this special arc is generated about 15,000 litres of air are blown per minute at gentle pressure and the issuing air contains about 1 per cent. of nitric oxide and is at a temperature of 600° to 700° C. It is cooled and then passes into two oxidising chambers where the combination of the nitric oxide with the oxygen of the uncombined air takes place, after which it passes into a series of five condensing towers. Down the fourth tower, which is filled with broken quartz, water trickles, and picks up enough of the nitrous gases to become 5 per cent. nitric acid at the bottom; this is pumped up and trickles down the third tower, the process being repeated until the liquid leaving the bottom of the first tower contains 50 per cent. of nitric acid. In the fifth and last tower the absorbing liquid is milk of lime, and the resulting mixture of solution of calcium nitrite and nitrate is treated with enough of the previously-formed nitric acid to convert it wholly into nitrate, the nitrous fumes evolved being led back into the oxidising chambers. The product is then concentrated until it solidifies as a material containing about 13 per cent. of nitrogen, or 75 per cent. of pure calcium nitrate. Owing to the hygroscopic nature of calcium nitrate, it is found better to introduce an excess of lime and manufacture a basic nitrate for agricultural purposes.

The present factory has three electric furnaces installed, each employing 500 kilowatts, and the production amounts to about 150 kilogrammes of nitrogen fixed per kilowatt year, or about one-fortieth of the maximum possible from the energy equation with which we started.

Professor Berkeland calculates that the cost of manufacturing calcium nitrate containing 13 per cent. of nitrogen is about £4 per ton, and that it can be sold at a profit at £8 a ton, which would be equivalent to nitrate of soda at about £10 a ton. The present factory at Notodden has been putting calcium nitrate on the market for about a year and a half, the rate of production now being about 100 tons per month. A new factory is being built which will generate about 30,000 horse-power, and contain larger furnaces, taking each 750 kilowatts, and when this is in operation it is expected the output will amount to a 1,000 tons per month. As a fertiliser there cannot be the least doubt that nitrate of lime will be just as valuable, nitrogen for nitrogen, as nitrate of soda. At Rothamsted a chemically prepared nitrate of lime has been used for two or three years for a special purpose on one of the mangel plots and it has given exactly equal results to the nitrate of soda plot alongside. Many field experiments have also been carried out with the electrical product in Norway during the last year or two, and have shown that the new material can be strictly valued against nitrate of soda on the basis of the nitrogen it contains. Indeed, on some soils it is likely to be more valuable, because, as will be shown in the next lecture, part at least of the lime base will be left behind in the soil as calcium carbonate. This will be an advantage in peaty soils and will also save clay soils from the peculiar wetness and stickiness which results from the employment of much nitrate of soda.

It will be observed that the commercial production of these two new manures which science promises to put very shortly at the service of the farmer, calcium cyanamide and calcium nitrate, is entirely dependent upon a cheap source of electric power; a cheapness which cannot be obtained when the electricity has to be generated by coal, but which is only attainable with water power costing practically

nothing beyond the interest on the capital sunk in the installation of turbines and dynamos. In this respect our country is always likely to be at a disadvantage, so that we must look to receive our supplies of these new nitrogenous fertilisers from countries which combine considerable elevations with an abundant rainfall. Indeed, in the British Islands the proprietor of a waterfall of any magnitude is in a somewhat delicate position, for should he wish to turn it into power for one of these purposes he is sure to find a strong body of public opinion arrayed against him, an opinion too which is generally capable of bringing a good deal of indirect pressure to bear.

Meantime, while these processes are being perfected and the price of the unit of nitrogen in fertilisers is being reduced until the nitrate of soda exporters have to struggle to sell their article at a profit at all, it is to be hoped that progress will also be made with the biological fixation of nitrogen. If clover sickness could be got rid of so as to enable the farmer to introduce what is after all much the most generally profitable leguminous crop more frequently into his rotation, if the nitrogen fixing bacteria in the soil could be given a freer play, and particularly if the nitrogen-wasting bacteria in the soil can be reduced, we shall go far towards rendering the farmer independent of any external nitrogenous fertiliser. It is not always realised how very wasteful of nitrogen our soil is; for example, of the nitrogen applied to the Rothamsted wheat plot as farmyard manure during the last fifty years only 21·6 per cent. has been recovered in the crop; where it has been applied to the mangel crop about 10 per cent. more has been recovered. The rest has either been permanently lost as free nitrogen gas or remains in the soil as compounds which will only be transformed into plant food with the utmost slowness. The nitrogenous compounds in the farmyard manure must be broken down and oxidised by bacteria before they are available by the plant. These figures show how imperfect the process is, because many of the soil bacteria are either wasters of or competitors for the nitrogen supplied as manure. Some recent experiments have shown that by partially sterilising a soil its powers of crop production are doubled or trebled, probably because the plant is relieved from the competition of soil bacteria wanting nitrogenous food for their own development. It is not too much to hope that in time these laboratory experiments will get translated into practice and the soil made a much more effective medium than it is at present.

However that may be, cheapened nitrogenous fertilisers will be of special service to British agriculture; we cannot compete when a crop has to be grown cheaply over a wide area of land, a paying wheat crop in this country must yield something like 40 bushels to the acre, and if the manure required to bring up our production to that average costs too much, it may not be possible to grow the crop at a profit either on a higher or a lower level of production.

INDIAN SECTION.

Thursday afternoon, December 13th, the RIGHT HON. LORD AMPTHILL, G.C.S.I., G.C.I.E., in the chair.

The CHAIRMAN, in introducing the author of the paper, said that Mr. Yusuf-Ali was a member of the Indian Civil Service, and that qualification ought to be a passport anywhere in the British Empire. Many present knew what it meant to be a member of that Service, but to the generality of Englishmen the members of the Indian Civil Service were unknown, except under one or other of two conditions. The first was that the civilians made themselves objectionable to the highest authorities; and the second was that the highest authorities made themselves objectionable to the civilians. He would not lend point to his remarks by doing anything so invidious as particularising, but he thought the audience agreed with him that that was the case. Besides being a member of the Indian Civil Service, Mr. Yusuf-Ali was also an Indian member of that Service. He hoped the audience realised what an amount of character, energy, and enterprise it meant for a young man of India to come over to this country, pursue his studies here, and enter into competition with Englishmen in order to get into the Indian Civil Service. Mr. Yusuf-Ali had done that. The author came from a part of India (the United Provinces) with which he (the Chairman) was not acquainted, so he could not speak of his service there, but he knew that Mr. Yusuf-Al had already made a name for himself in this country, and that he was a man of very exceptional literary ability. The fact that he gave up time when he was on furlough to read a paper of such an interesting nature spoke for itself. But, in addition to that, Mr. Yusuf-Ali had written a monograph on the subject of silk fabrics, which was published by the Government of India; an article on civic life in India, which appeared in the *Asiatic Quarterly Review;* and so versatile were his talents that he was able to write a criticism of Goethe in the *Contemporary Review.*

Nothing could be more welcome to Anglo-Indians than that an Indian member of the great public service which administered the vast dominion of India under the British Crown should come to England and of his own free will endeavour to give information about his fellow subjects, and generally to allow those present to make acquaintance with one of them, and through him to hear the views and ideas of his fellow countrymen.

The paper read was—

THE INDIAN MOHAMMEDANS: THEIR PAST, PRESENT, AND FUTURE.

By A. Yusuf-Ali, M.A., LL.M., I.C.S.

"The more I learn about the Mohammedans," said a recognised authority on Indian matters the other day, "the more I learn to respect them." If the British public could entertain a similar feeling for the Indian Mohammedans, they would find it a little easier to understand some of the controversies which vex the Indian atmosphere. They would also, I fear, feel a little less confidence in putting forward those cut and dried schemes which, like English furniture, make a splendid show in Tottenham Court Road, but are apt to warp in the exceedingly dry climate of the Indian hot weather. It is certain that an imperfect appreciation of the Indian Mohammedans is at the bottom of much of the misunderstanding that exists between them and the English, and between them and their Hindu fellow-subjects. Let us see if we can briefly review their past history, their present position, and their future prospects. In doing so let us hold in view not so much a narration of events as an appreciation of the moral factors which have made the Indian Mohammedans what they are, and which will doubtless operate in their attitude to future events.

The interest of the early Mohammedans in India was three-fold, viz.: commercial, missionary, and political. The ordinary assumption that it was purely and exclusively political, can be easily shown to rest on a fallacy. To some minds, nurtured on stories like that of "Alexander and the Robber," high politics seem always identified with pillage and brigandage. In their eyes no wars can be right even if they are just. But if the causes of the great movements in political history are examined and analysed, they will be found to be of enduring importance only if they are the visible embodiment of moral and economic forces, while they merely float and burst like bubbles if they are called forth by the ephemeral prejudices or passions of unthinking multitudes.

The commercial interest in India of the Arabs and other nations of Western Asia (including Egypt, if we may adopt the definition of Herodotus), dated from a time long anterior to the birth of Islam. The Egyptians had a considerable maritime commerce with India before their country fell under the influence of Greece and Rome. The Arabs of the Red Sea littoral were always intimately connected with Egypt, and doubtless learnt from that country (if they had not discovered it themselves) the secret of the monsoons and, therefore, of the navigation of the Indian Ocean. When Egypt fell into confusion, they became sole masters of the commerce and carrying trade of the East. The quest after spices, gems, and ivory cast a glamour round the names of Ceylon and India, and the name of India (Hind) is even found as a feminine personal name among Arab women in pre-Islamic poetry. The tradition that Adam's Peak in Ceylon was the place where our first parents set foot on their fall from the Garden of Eden, invested the island with something like sacred associations, and in later times we hear of the pilgrimage of Arabs to what they conceived to have been the cradle of the human race.

Such was the soil of ideas, in which, with the dawn of Islam, was sown a seed of greater vitality than any which had germinated before. The vision of Islam was the brotherhood of the world, the union of all in a universal and democratic Church and State. The missionary spirit was strong and fervid. Says the Koran xlii. 14:—

> "Summon them to the Faith, and walk righteously therein, following the law rather than their desires. Say—'I believe in all the Revelation that God has sent, and I am bidden to decide justly between you. God is our Lord and your Lord. We have our works, and ye have your works; between us and you let there be no strife. God will make us all one, and to Him shall we return.'"

It is uncertain whether the settlement of the Mappilas (Moplas) in Southern India owes its origin to missionary or to commercial motives. Their advent is dated back to the second century of the Hijra (eighth century A.D.), about the same time as the Arab conquest of Sindh in the north.* They still form

* T. W. Arnold: "The Preaching of Islam," p. 216; "The Tohfat-ul-Mujahedin," translated by M. J. Rowlandson.

an important Arab colony in the Tamil country. So completely have they assimilated themselves to their surroundings that they speak Tamil, read the Koran in that language, and are somewhat isolated from the rest of the Mohammedans of India. In the Khilafat of Mansur, and subsequently, several Arab missionary settlements were established, and their representatives now form well-knit and prosperous Nonconformist Muslim communities on the west coast of India.

The political dealings of the Mohammedans with India are better known, because the eye can follow the movements of the big battalions, whereas the still, small voice that inspires them requires delicately adjusted minds, like Marconigraph receivers, to perceive its ethereal promptings. In the Khilafat of Osman (643-55), Syria and Egypt already formed part of the Muslim Empire; and on the east Irák formed a frontier province, with the eyes of pro-consuls already watching for new worlds to conquer. The prospects, however, of a political extension in the east were not favourable. A man sent to the frontier of India returned with this report:—"The water is scarce, the fruits are poor, and the robbers are bold. If the troops sent are few they will be slain; if many, they will starve." The Khalifa asked whether he spoke accurately or poetically (*dichtung oder wahrheit?*); to which he replied that he spoke according to his knowledge.*

It was early in the eighth century of the Christian era that the first political foothold was obtained by the Mohammedans in India. A vigorous force of expansion was then pushing the outposts of the Arabian Empire in all directions. In 710 Khorasan was captured, and the first serious contact of the Mohammedans with the Tartars began. In 711, in the extreme west, Tarik crossed the Gates of Hercules into Spain, and built the strong fortress of Gibraltar. In 713 Mohammed ibn Kásim, or, as he is usually styled, Mohammed Kásim, captured the town of Multan, which was then included in Sindh. At that time, apparently, there were already some Muslims in the country. The *Chachnáma*, which is our great authority for the stirring story of the Arab conquest of Sindh, gives us incidentally a picture of the state of the country. The people were divided into many races and tribes, and the Jats and the Meds welcomed the conquerors. The castes of merchants, artisans, and agriculturists are found in full working order. The religion is a form of Buddhism, but the Brahmans assert their supremacy and are followed by the people. Heavy engines of war are brought up by the Musalmans, and their success is, among other causes, due to the possession of sea-power, with a base in the Persian Gulf. In fact, the expedition itself was rendered necessary because of piratical acts at the mouth of the Indus, which the Hindu princes had no power to suppress or control, and which preyed upon Muslim commerce with Ceylon.

The civil institutions established in Sindh were full of toleration and equity, and their story forms one of the brightest chapters in Muslim history. Mohammed Kásim's address to the Brahmans whom he appointed as revenue managers shows both political sagacity and something of those large views which afterwards blossomed out in Akbar. "Deal honestly," he says to the Brahmans, "between the people and the Sultan, and if distribution is required, make it with equity, and fix the revenue according to the ability to pay. Be in concord among yourselves, and oppose not each other so that the country may not be distressed."* This is not only the attitude of Mohammed Kásim himself, but also of Hajjáj, the Governor of Irák, whose agent he was in the expedition. Hajjaj in a letter of appreciation praises him "for your military conduct, and for the pains you have taken in protecting the people, ameliorating their condition, and managing the affairs of the government."†

Many mosques and schools were built after the occupation, and public functionaries appointed to administer the law and decide disputes. But there was a large measure of toleration granted to the Hindus. On their petition that the Hindu temple should be allowed to be repaired and their religious rites carried on as before, the following orders were passed:—

"They have been taken under our protection, and we cannot in any way stretch out our hands upon their lives and property. Permission is given to them to worship their gods. Nobody must be forbidden or prevented from following his own religion. They may live in their houses in whatever manner they like."‡

This was in the earliest days of Muslim dominion in India. The Arab power was firmly established in Sindh, but it soon became

* Sir H. M. Elliot's "History of India as told by its own Historians," I., 116.

* *Chach-náma, apud* Elliot's History, I. 184.

† *Id.* I. 188.

‡ *Id.* I. 185-6.

isolated from the rest of the Saracen Empire. It should be noted that this dynasty was the only one in India which was established directly under the guidance and initiative of the central Khilafat. Shortly afterwards rival Khilafats were established in the east and in the west, and many internecine wars occurred among the Muslims themselves. Their power continued to increase, but more under separate groups or units than under a central recognised authority. The attention of Muslim merchants, travellers, missionaries, geographers, historians, scientific men, and men of letters, continued to be directed towards the moral, intellectual, and material wealth of India. A merchant named Sulaiman embarked on the Persian Gulf and made several voyages to India and China. He wrote a valuable account of his travels, which is one of our early sources of information on India as seen by the Mohammedans. This was about the year 851 A.D. Accounts of this kind must have been fashionable about that time, for they were collated and edited by literary men who had access to libraries and were able to co-ordinate and comment upon the knowledge obtained at first hand by travellers. Such an editor was Abu Zaid, who met the famous geographer and historian Mas'udi in the literary city of Basra about 916, and edited the merchant Sulaiman's "Travels" in the light of the further information which he received from that great master of Arab style.

So far we have been looking at Muslim civilisation as represented by the Arabs, among whom there was a many-sided activity and the traditions of an intimate contact with the civilisations of Western Asia and the Mediterranean, in other words, the highest civilisations to which the world had yet attained. With the opening of the eleventh century comes a new racial force into Islam as represented in India. The expansion of the Turks, a comely, vigorous, blunt, and honest race, with primitive virtues and primitive failings, from their pasture grounds in Central Asia, had been proceeding with varying fortunes for centuries. The adoption, by the soft Kalifas of Baghdad, of a Turkish body-guard, gave them a status in the counsels of Islam. Their gradual reception into Muslim communities, as slaves, as freedmen, as soldiers, as leaders and rulers, prepared the way for that pre-eminence which they subsequently established with unquestioned power after their reception bodily into the fold of Islam.

Mahmud of Ghazni was a product of the general Turkish advance which took the Muslim world by storm in the fifth century of the Hijra. Of Turkish descent on his father's side and Persian on his mother's, he had the inflexibility and the refinement which characterise the two races respectively, while the Afghan *milieu* in which he won his spurs and established his court left its traces in the narrow sectarianism and the love of greed of which he has been accused. Mahmud made periodical invasions of India, to the number of 13 or 14, between the years 1001 and 1030, with the triple object of obtaining military glory, compassing the destruction of idols, and carrying off the rich booty which he found in temples like those of Mathura and Somnath. His own city of Ghazni he adorned with a marble mosque to which he made gifts of lamps studded with gems, like those noble specimens of Saracenic art which form the wealth and glory of the Cairo Museum. A library and museum were also added to the attractions of the city, which drew to itself men of art and learning, historians and poets, from different parts of the Muslim world. Firdausi, the national poet of Persia, has made him immortal, not only for his generous love of poetry, but, in a contrary sense, for his ignoble avarice.

The justice he administered was stern and pure, and his ceaseless activity and conscientious discharge of his duties of kingship bring him into strong contrast with the inglorious and ease-loving potentates into whose weak hands had fallen the direction of the central authority in Islam. The chief fact that stands out in the internal politics of India is again the hopeless divisions of the people, and the implacable hatred with which the Raja of Kanauj helped in the destruction of the Raja of Delhi. An instructive commentary on Mahmud's victories is supplied by the patriotic verses of the Hindu bard Chand Bardai, whose intimate picture of the politics of the Delhi Raja's court supplies the much-needed corrective to the indiscriminate panegyrics of the professed historians of the reign of Mahmud the Iconoclast.

The invasion of Muhammad Kásim had been by sea; that of Mahmud and all subsequent Muslim invasions were through the passes of the north-west frontier of India. Afghanistan now becomes the stepping-stone to India. The Arab invasions had been made by generals obeying the orders of the Governors of Irák, whose power was subject to the juris

diction of the Khalifa himself. The local commanders had to refer many questions for decision to the stay-at-home authorities, who might or might not realise the difficulties of the local situation. A wrong decision might jeopardise thousands of lives, and undo the work of brilliant politicians and skilful soldiers, as, in fact, happened in the case of Muhammad Kásim himself. The invaders through Afghanistan came on their own account and were their own masters. They were, therefore, able to follow a strong and less vacillating policy, and they gradually settled in the country and built up the foundations of a fabric on which the modern superstructure of the Indian Empire rests.

It should be noted that subsequently to the Arab conquest India under Muslim rule never formed a part of the Muslim Khalifate, or any of the rival Muslim Khalifates, but was a separate and independent kingdom, with ecclesiastical pretensions of its own. Even Mahmud, who had strong ideas of loyalty to the ideal Muslim State, whose boundaries were conceived to be co-extensive with those of the Muslim Church, in practice departed widely from that conception. In his later career he sought and accomplished an expansion to the sea, and maintained a naval force, with which he policed the Indian Ocean, and claimed to guard the pilgrim routes and protect the pilgrims to Mecca. As an issue of independent coinage marks an assertion of independent sovereignty, so the claim to protect the pilgrims to the sacred cities of Arabia is tantamount to an assertion of independent sovereignty in a prince of Islam.

After the time of Mahmud of Ghazni there were many invasions and many Mohammedan dynasties in India. Their story forms a tedious record of wars, revolutions, rebellions, and family feuds. There were some strong or interesting figures standing out on the page of history, such as Sultana Razia Begam, who rode on horseback like a man and affected the style and title of Sultan; and pious kings, who never touched a pice from the public treasury, but maintained themselves, according to the Muslim ideal, by working at some private trade in the intervals of their State duties. But, apart from isolated instances, there were no men of broad views or great ideas who were able to leave their impress on the history and institutions of mankind at large until we come to the spacious times of the Great Moghals.

This period is well known to the average English reader, and it will not be necessary to enlarge upon it. Before we glance at the personality of Akbar, the greatest of the Moghals, let us for a moment place before our eyes a picture of what these Moghals were, who were destined to play so large a part in the history of India. In fact, the name "Moghal" is a misnomer; they should rather be called Chaghtai Turks. Fortunately we have materials for judging what manner of men they were, not only from the memoirs left by Bábar, the founder of the dynasty in India, but the intimate revelations of their inner life and domestic relationships left us from the facile and lively pen of one of their princesses. Within the last few years Mrs. Beveridge has published a Persian transcript and an admirable English translation of "Humáyun-náma," a memoir by the princess Gul-Badan. She was a daughter of Bábar and an aunt of Akbar, and lived through three great reigns to witness scenes of triumph and disaster, of reconquest and organisation. Her memoir was composed in Akbar's reign to serve as part of the materials for the history of that monarch and his house. The manuscript which has been published breaks off three years before Akbar's accession, and, therefore, it fails in its original purpose of informing us as to the inner history of her illustrious nephew. But with the delicate touch of a feminine hand she sketches for us the internal lineaments of the early Moghals and their domestic history as it affected public events, and she does it with such fidelity and in such detail that it brings home to us the inner life of the people among whom Akbar was born and bred.

They were a rosy-cheeked race, who came over with Bábar to conquer Hindustan. They were fond of gardens, canals, fruits, and even wine. They were hardy, and loved all field sports, but they also cultivated music, poetry, and letters. Their women appeared unveiled before men, and, indeed, were always mixed up in the highest affairs of State. The greatest deference was paid to aunts and women of an elder generation. Not only did Gul-Badan write verses herself, but her niece, Salima Sultan Begam, was an accomplished poetess, and collected a library, to which apparently a copy of all books had to be contributed, which had any currency in court circles. Here we may see the germs of the Copyright Acts, which in modern countries serve to keep their central libraries supplied with copies of all the publications that issue from the Press.

The scenes in the domestic circle were genial and sometimes full of incident.

When Bábar wins his splendid triumph in India, he sends presents to all the ladies left behind in Kabul, who have doubtless been watching events with the same keen zest with which Clytaemnestra in the play watches for the return of Agamemnon, but with far purer and worthier motives. The presents are not sent in the mass, to be scrambled for or divided by chance or seniority. Bábar himself makes out a careful list, and selects an individual present for each, not forgetting a touch of humour in the present to a little child. With the greediness of a little fellow he is expecting a great many *Ashrafis* (gold coins), but he is told that only one has been sent for him and he is to receive it blindfolded. All the Begams assemble in a solemn session, the boy is brought into their midst with his eyes tied up, and a single gold Ashrafi is hung round his neck—but what a weight? It is a lump of 30lbs. and he can scarcely carry it. Amidst much laughter his eyes are opened, and he finds that he is the lucky recipient of a special Ashrafi—or rather medal—struck for him by the kindly thought of his genial relative. It contains more gold than the number of Ashrafis which he would have dared to ask for himself, if it had been left to his choice. But the humour of it all and the special distinction which marks him out show how Bábar's thoughts dwelt on him, as they did indeed on each individual of his household, man, woman, or child, in the midst of a busy campaign.*

While I am on the subject of the Begam Gul-Badan, it may be of interest to give a few further instances of the part which Mohammedan women have played and are likely again to play in Mohammedan history. The instances are by no means as few as some people would probably suppose, who admit that Islam has great qualities, but say that it has not done justice to women. Some of the Prophet's most burning speeches relate to this very theme—justice and fair dealing to women. Indeed, some of the heroines of the early harvest of Islam did not need to be protected from the men—quite the contrary. The battle of the Yermouk, which decided the fate of Syria in favour of the Arabs, was won by the superb courage of the women. Thrice had the warriors of Islam hurled themselves against the Roman phalanx, and thrice had a remnant of them retreated, bleeding and broken. But the Arab women behind the ranks ever urged them to charge, and to charge again. Abu Sofyán was struck on the face with a tent-pole by a woman. In these circumstances retreat was impossible; they went forward, broke the phalanx which had come to look upon itself as impregnable, and won the field.* A similar story is told about the battle of Bokhara in the 90th year of the Hijra. Towards the end of the eighteenth century our own Nizam had a regiment of Amazons, the Zafar Paltan, which is said to have fought as well as the men.† I have already mentioned Sultana Razia Begam as a lady accomplished in affairs of State. An even more accomplished Princess was the great Nur Jahan Begam, the consort of Jahangir. While he was wasting his energies in drunken orgies, she was virtually ruler of the state, and her name appears on some of the coins. Indeed, Tavernier tells a pretty story (which as Mr. Stanley Lane Poole points out,‡ was probably a popular legend) that she designed and issued the famous Zodiacal Mohurs of Jahangir. She was as just and liberal to the poor as she was peerless in her beauty and accomplishments. Many a noble lady's formula for attars and perfumes at the present day in India is traditionally ascribed to Nur Jahán. All suffering found ready help at her hands.§

Nor must we forget the literary ladies. We have seen what were the accomplishments of Gul-Badan and her niece. Zaib-un-nisa, the daughter of Aurangzeb, wrote a commentary on the Koran, and a volume of poems in Persian. To a later day belongs Gunna Begam, wife of Ghaziuddin, who founded the city of Ghaziuddin-nagar, which the railway authorities have re-christened Ghaziabad in the interests of brevity. She wrote Urdu verses, and her master in the art was no less a person than the poet Sauda. The story is that she was betrothed to the son of the Nawab Safdar Jang of Oudh, but eventually married the Wazir of the Empire,|| and the seeds of enmity thus sown created a permanent cleavage in politics which lasted till the dissolution of the

* This story is constructed out of a paragraph on p. 11a of the MS. as published by Mrs. Beveridge (Humayun-nama). I take Asas to be a little boy, perhaps a nephew or grand-nephew of Bábar. Mrs. Beveridge (p. 96, n. 4) takes Asas to be an old man and a servant. The words describing him are doubtful, but to me the story sounds more plausible if told of a boy.

* Elliot: History I., 463.

† Irvine: Army of the Indian Moghuls, p p. 165-6.

‡ Coins of the Indian Moghals.

§ Elliot: History VI., 398-9.

|| Beale's Oriental Dictionary, *sub nomine*.

Moghal Empire. Nor must we omit to mention the late Begam of Bhopal, whose literary accomplishments were exceptionally remarkable in a line in which literary gifts are hereditary. At the present day a great deal of literary talent lies buried behind the pardah, as I know from personal knowledge; but alas!

> Full many a gem of purest ray serene
> The dark unfathomed caves of ocean bear;
> Full many a flower is born to blush unseen,
> And waste its sweetness on the desert air.

In saying all this about Mohammedan women I am in no sense defending the abuses which have sapped the foundations of our social system and ended in the undoing not of women but of men. I have merely tried to point out the possibilities by means of concrete instances. The rising generation of Mohammedans are becoming more and more conscious of the abuses which shut out men from the most charming portion of mankind, those whose softening influence and gracious presence lend, as we find in Western lands, an added dignity and sweetness to life. Towards this ideal no family has worked with greater fidelity and success in India than that of the late Mr. Badruddin Tyabji, as all who were privileged to have an *entrée* to his family circle know and will remember with feelings akin to reverence.

The character of Akbar and the great forces for which he stands in Indian history are happily well known. Colonel Malleson's monograph on him, and Lord Tennyson's poem, "Akbar's Dream," have brought home his ambitions and his ideals to Englishmen who do not ordinarily seek inspiration in Indian history. A man of indomitable will and cool courage in the face of danger and difficulties, he used his successes for the furtherance of justice and equality amongst all men. Great in war, he was greater in peace. Fond of riding, hunting, and swimming, he studied a serious purpose in life, and marked out his time so as to hold a just balance between his multifarious interests. Under the influence of Abul Fazl and Faizi, he approached the deepest problems of man's intellectual and spiritual destiny, seeking wisdom not in one school or form of thought, but wherever he could find it. With the assistance of Todar Mal in revenue administration, and of Raja Jai Singh of Jaipur, the soldier-astronomer who fought his battles in far Kabul with a loyalty that does credit to both King and vassal, Akbar built up a sound system of administration which has commended itself to the judgment of the Imperial race of Britain. He, no doubt, had precursors in men like Sher Shah Pathan; we all build on other people's foundations. But his merit consisted in breathing into the whole system the soul of his personality. He grasped the cardinal principle of statecraft that no country can flourish in stability or permanence in which race fights against race and religious animosities have sway, but that the happiness of princes and peoples alike depends on unity of will, co-operation in self-sacrifice, and firm, unbounded loyalty to and confidence in all political ideals.

Akbar was not only great as an emperor: but he was a man of supreme humour. This is a point in his character to which sufficient justice has not been done. If half the popular stories that are current about his combats of wit with Bir Bal and others are apocryphal, the fact that so many *bon mots* are referred to Akbar shows what reputation he had for wit and geniality—and no sour man can possibly acquire such a reputation. The fact that so many of these jokes are against him only makes his toleration and good humour all the more pre-eminent. We have time for retailing only one. Akbar and Bir Bal once contended as to which of them could first overcome the other in conversation. A time was fixed in advance when the contest was to commence. Akbar primed himself with many wise saws and modern instances, knowing that the Hindu's memory was good and equal to many resources. When the time arrived, Akbar began. He made many sallies, and left many openings to lure his opponent on. But Bir Bal smiled placidly all the time and never said a word. At length Akbar said, dealing (as he thought) the hardest and straightest blow of all: "What can you do when you have to deal with a fool all the time?" Quick but quiet was Bir Bal's reply "In such a case," he said, "I should hold my tongue." Akbar ungrudgingly awarded him the prize of the contest.

The decline and fall of the Moghal Empire was due to many causes. Among Akbar's successors were strong and able men, but no one combined in himself the gift of that winning grace which made friends wherever he went, with that business ability, industry, and power of organisation, which could turn abstract ideas into concrete institutions. The jealousies and intrigues among the nobles and satraps were a strong

disintegrating force, which even Akbar could not always keep in subjection, but which broke out with destructive force when a strong policy was allied with intolerance and hatred of the Hindus. Above all, the mercenary army was allowed to fall into a state of indolence and disorganisation. The conquest had been achieved by strong men fighting for honour and glory · the empire was lost by weak men, who had no moral force of cohesion, though they never lacked personal courage. Mr. William Irvine has minutely investigated the military organisation of the Moghals, and this is his verdict: "The more I study the period the more I am convinced that military inefficiency was the principal, if not the sole, cause of the Empire's final collapse." *

In dealing with the present position of the Indian Mohammedans it is curious to observe the alternating favour and disfavour in which they have been held at different times by English opinion. Warren Hastings was catholic; he and the immediately succeeding generation of Anglo-Indians found much that was attractive in the Mohammedans, but, above all, they remembered their history and treated it with respect. After the Mutiny the Muslims fell under a cloud, undeservedly, because their premier chief, the Nizam, remained loyal to the core, and his great minister, Sir Salar Jang, practically kept the peace of the Deccan and of Central India. The feeling of suspicion against Mohammedan loyalty grew and grew, until it found a visible peg to fasten itself upon in the Wahabi propaganda, and culminated in a series of State trials from 1864 to 1871. In 1871 a miserable assassin struck down the English Chief Justice of Bengal on the steps of his own court, and in the state of excited feeling which then prevailed, that despicable act was fastened upon the community which he had disgraced. Calm observers, however, even then raised their voice against the injustice of attaching the stigma of an individual's crime to a whole community, whose antecedents and principles alike made such a crime peculiarly abhorrent to their moral and religious feelings. The law is reverenced by Mohammedans more than power and dignity. The late Prof. E. H. Palmer wrote an Urdu letter, pointing out the injustice of connecting such a crime with the feelings of the Mohammedan community, and the letter has been considered of sufficient importance to be published in Sir Walter Besant's "Life of Palmer." Sir William Hunter wrote a book with the significant title: "The Indian Mussulmans; are they Bound in Conscience to Rebel against the Queen?" Though he showed, on the whole, considerable sympathy with the Mohammedans, his views were so coloured with a misconception of the Mohammedan position that Sir Syed Ahmed Khan, of Aligarh, issued a rejoinder in the form of a review.

It is necessary, even at this day, to clear away the prejudices and misconceptions that attach to the Mohammedan position in connection with the Wahabi movement in India. The Indian apostle of the movement was Syed Ahmad of Bareli, who proclaimed a Jihád on the North-West Frontier in 1830, and was slain in 1831. This Syed Ahmad is in no way to be confounded with Sir Syed Ahmed Khan of Aligarh: the two men were as the poles apart. The Wahabi movement, in its earliest phases in India, had two aspects, the religious and the political.

The religious aspect was the more important of the two, and has proved to be the more permanent. In this aspect Wahabiism aimed at going back to the pristine simplicity of Islam, and sweeping away the accretions (such as the reverence shown to *tazias*, graves of ancestors, and saints) which have grown up in India. It also questioned the authority of interpreters of the Sacred Book, and would substitute a plain and simple appeal to the sources of the Law rather than to the network of glosses and analogical systems founded upon it. Put in this abstract way, it could justly be called the extreme Evangelical School in Islam, and has many of the characteristics of evangelical schools and revivals elsewhere. The spirit in which it was preached was that of hostility and an uncompromising attack on the existing order of things, and, therefore, the majority of Indian Mohammedans have always rejected it not only with scorn, but with something of the bitter rancour which is always called forth in religious controversies. In orthodox circles the name "Wahabi" became a term of abuse of even a deeper dye than "atheist" or "unbeliever."

The Wahabis as a religious sect in India are now of little importance, but their religious fervour has stirred the more orthodox schools to set their own houses in order. A number of new and liberal movements in Muslim theology have sprung up, of which as yet we are only seeing the early beginnings.

* William Irvine: "Army of the Indian Moghuls," p. 296.

The political aspect of Wahabiism never appealed to even an appreciable section of the Indian Mohammedans. It arose to a considerable extent from a misappreciation of the lessons to be learned from the twelve centuries of Mohammedan history which had already witnessed the rise and fall of many ideas. These ideas had failed, when translated into facts, to realise the ideal brotherhood of mankind. The further century which has since elapsed has added a more conclusive chapter of warnings against the thoughtless admission of the foul and tainted exhalations of rough-and-tumble politics to what should be the pure and serene atmosphere of religious peace and freedom. The original relation of Church and State at the birth of Islam was so close that the term Erastian has been applied to the Muslim idea of a Church; it would be more correct to say that the Muslim conception of a State was theocratic. This conception, unredeemed by the conditions which originally gave it reality, colours the schemes of all visionaries who do not learn wisdom from the lessons of history. The Khalifa, abstract and elective, is the counterpart of the Stoics' perfect man. What a cruel mockery then to dispute, on the religious plane, about the merits of a concrete embodiment which may be a negation of all the virtues postulated! Nor is the spectacle edifying when we see a man claiming to guide events which he does not understand, and hurling anathemas at the heads of other men of similar pretensions. It may be said that the collective conscience of Islam, though it has never formulated the doctrine in plain terms, has come to recognise that it tends to nobler spirituality in religion and greater strength in politics to conceive of the Mujtahid of the age, or several Mujtahids—to adopt a term which Akbar sought to apply to himself—as a personality distinct from the king or leader who uses judicial force for the suppression of anti-social force. This lesson has been specially, if unconsciously, brought home to the Indian Muslims. Even the small following which adopted the religious views of Wahabiism has practically repudiated its political corollaries. The sect has already been split into two. One portion openly and professedly reject the dangerous doctrines of Jihad, and the other hedge them round with so many qualifications that for practical purposes they may be considered now to hold the same political views as the rest of their co-religionists in India. These sects are principally found in Bengal, and the last census report of the province gives an excellent account of the practical trend of their doctrines. The orthodox schools (Sunni and Shiah) have always opposed the ultra-dogmatic tenets of Jihad, by means of numerous Fatwas and authoritative opinions.

I have lingered so long over this matter in order to show that there is nothing either in the religion or the history of the Indian Musalmans to prevent them from taking an honourable place as citizens in a free and progressive Empire. As to their relations with the British Government, they have tended more and more, within recent times, towards cordiality. His Highness the Nizam has always been a faithful ally of the British power, but never have his relations with that power been more cordial than they are now. The recent abolition of quarantine at Bombay for the pilgrimage to Mecca has brought solace to many a devout Muslim who had never heard and who never cared about the controversies raging in a certain portion of North-Eastern India. The statesmanlike reply of the Earl of Minto to the Simla deputation in October, and the speeches of Sir Arthur Lawley, have further helped forward the *rapprochement*. The way seems now clear for a strong united patriotic party, based not on sectarianism or religious differences, but on a steadfast and manly recognition of all the best interests of India.

For it must be insisted upon that the Muslim position is not grounded upon a blind and implacable hatred of the Hindus, or of any other class of His Majesty's subjects. A foundation of hatred or hostility can never support an edifice of national life, and would be subject to sudden earthquakes when the forces of disorder are let loose. But moral courage, a happy combination of independence and discipline, a directness of aims, and, above all, truth, integrity, and loyalty, are the factors which help forward orderly and sustained progress.

The Muslim leaders have shown these qualities in the past, and will show them again when necessary. Of course, I must be understood to claim no monopoly for them in these matters to the exclusion of other Indians, but I am focussing my attention at the present moment to the community whose fortunes we are interested in to-day. The noble monument of the genius of Sir Syed Ahmed is seen in the living college at Aligarh to-day, and Mr. Badruddin Tyabji has left an inspiring example in his efforts for women's education and emancipation, and in the sturdy

good sense and independence with which he always approached any questions which he handled. It would not, perhaps, be becoming to attempt an appreciation of living leaders; but we are happy in possessing not a few —authors, jurists, lawyers, poets, professors, religious dignitaries, and land-holders — of whom any community may well be proud.

The future of the Muslims rests entirely in their own hands. They number 62½ millions in India, against a total of 250 millions in the world, as estimated by a recent authority. It is true that they are a minority among the 294 millions of the people of India; but they are increasing faster than the Hindus, and if they have any consciousness of moral worth, their influence is, or might be, greater than can be measured by mere numbers. Except in Kashmir and Eastern Bengal, where they form the rural cultivators, and the poorer mass of the people, their centres of population are usually in the towns, and their occupations are usually those above what are called the *Razáil pesha*. Their skilled artisans are famous and have been famous for ages. In the learned professions they occupy a respectable position, though they ought to be better represented than they are. In administrative positions in which manliness, open-air work, and knowledge of men are the chief requirements, they excel. Their literature is both rich and vigorous, and the tinge of melancholy which seems to have rendered turbid its lucid stream will disappear with the advent of larger hopes and fresh streams of thought. It is less sectarian perhaps than the literature of any other people in India. Was it not Malik Muhammed of Jáyas (*circa* 1540) who wrote the Padmávat in excellent Eastern Hindi and prepared the way for that deservedly popular Hindu classic, the Ramayan of Tulsi Das?

What they chiefly require is organisation. Such splendid material should not be wasted for lack of co-operative effort. The different Anjumans which they already possess are excellent institutions, but the Muslims require a healthy organisation of their Church on a purely religious, though broad and non-sectarian, basis. Their social system requires organisation on progressive lines, with more of the valuable benefits of women's co-operation. I have an idea that the women in Turkey, Syria, Egypt, and Algeria (especially the last) are far more advanced than the Muslim women in India, and I am told by a Persian friend—a great admirer of Qurrat-ul-Ain—that the women of his nation are the most advanced of any in Islam. Then, again, our charities and *wakfs* require a thorough examination and complete reorganisation, so that our modern ideas may be brought to bear, as far as is consistent with the donors' wishes, on their administration. We should make these benefactions subserve national progress instead of chartered indolence. Could not Mr. Ameer Ali give us a detailed and reasoned exposition of the subject, dealing not only with abstract generalities, but with concrete and specific instances?

Above all we want a careful and thorough review of our educational position, not only as it touches the men but also as it affects the women. The late Syed Mahmud's book on the subject contains excellent material, though it requires to be digested, brought up to date, and enlarged in scope. The review by itself would be useless if it leads to no practical results. In higher education the results achieved by the Aligarh College are striking: the proportion of Muslims in the United Provinces under collegiate education is a good deal higher as compared with the Muslim population of the province than the proportion of Hindus receiving higher education to the total Hindu population in the province. This fact I mention not for self-congratulation, but in order to draw attention to the other side of the picture in regard to primary and secondary education, and particularly in regard to the education of girls. A system in which the primary and secondary education is not put on a sound and popular basis is liable to become top-heavy. In the Punjab, the Anjuman-i-Himayat-i-Islam has done very good work in the direction of primary and secondary education, and has alway kept in touch with the masses of the people. Their example is to be commended to the Muslim community of the whole of India.

Self-help is a principle which cannot be too much emphasised and urged upon the attention of the Indian Muslims. If they rely upon themselves, they are more likely to obtain the encouragement and practical assistance of the Government than if they constantly harped on abstract principles, or built futile hopes on the treacherous sands of preferential treatment. I have no hesitation in saying that such treatment would be demoralising to themselves, and quite out of the question as the sole crutch to rely upon in this twentieth century. Frank, sturdy, and true was the advice given by the Governor of

Madras (Sir Arthur Lawley) the other day, to a deputation that waited upon him :—

"You tell me," he said, "that a change has come over the spirit of your dreams, that there is a change in your aims and aspirations, that you put before yourselves the goal of national progress. You ask my aid in helping you to attain that goal. I am afraid the days of magic are over. Even a Governor does not possess any mystical power whereby he can expedite to any appreciable degree the advance of national progress; but when you rally your forces to the campaign against prejudice and ignorance, when you make Progress your battle-cry, then, indeed, I am ready to enter into an alliance with you, defensive and offensive."

If I were asked to make a banner for this peaceful campaign of progress, I should inscribe on it the following mottoes: Staunch loyalty to our Sovereign; Patriotism for our country; Friendliness to all our neighbours; and, the sum and substance of them all, Absolute truth to ourselves.*

Note about the Slides shown.

Portraits of celebrities, including Their Highnesses the Nizam, the Aga Khan, the late Begam of Bhopal, Miss Fyzee, the late Justice Badruddin Tyabji, the late Sir Syed Ahmed Khan, Maulána Háli, the poet, and the Emperor Akbar, from a portrait in Valentyn's "Lives of the Great Moghals" (in Dutch), Amsterdam, 1726.

Buildings in Fatehpur Sikri, Sikandra, Delhi, and Agra, to illustrate Moghal and earlier Mohammedan architecture and decorative arts.

Jahangir's zodiacal coinage, to illustrate the legends that gathered round Nur Jahan.

Badshahi Sarai, in Nur Mahal Town, District Jalandhar, built by order of the famous Moghal Queen—to illustrate the manners of the period.

Mausolea of Hyder Ali and Tippu Sultan, and Jami Masjid built by Tippu—to illustrate late Mohammedan architecture in the South.

Bijapur Jami Masjid—to illustrate the grand and original style of architecture, showing Byzantine influences, developed in the South under the dynasty of Yusuf Adil Shah, who was a son of the great Murad or Amurath, Sultan of Constantinople.

The great Bijapur gun, known as Malik-i-Maidan—to illustrate the design and finish which the Mohammedans of the sixteenth century were able to carry out in the art of casting metals. Diameter at breech, 4 ft. 10 in. Col. Meadows Taylor, in 1866, described it as the largest piece of ordnance in the world. Cast by a Turk, Muhammad bin Hasan Rumi, in 1548.

Mosque at Champanir, panel of Arabesque in ceiling—illustrating early Mohammedan art in the old capital of Gujerat.

Ahmedabad architecture, including a window of palm tracery from the Bhadr—illustrating the limits of the natural and the conventional in decorative design. *Cf.* Mendelslo's description (1662) of two rows of palm trees and tamarinds in this very place.

* Mr. Yusuf-Ali has reprinted his paper and the discussion on it as a pamphlet, which will be published by Messrs. P. S. King and Son, 2, Great Smith Street, Westminster.

DISCUSSION.

The Chairman thought the audience had listened with pleasure and interest to the eloquent and instructive address which Mr. Yusuf-Ali had given. He hoped the author would not think it a mean compliment if he said that he had been much struck with the extreme facility and eloquence he displayed in a language which was not his own. If it was borne in mind how few Englishmen there were who had a thorough command of any foreign language, he thought it would be recognised that it was no mean achievement for an Indian to speak and write English as Mr. Yusuf-Ali did. Although the author had not gone any too far into the past history of the Mohammedans, he regretted that the paper was not extended in order that those present might have heard something further about the present and the future. That was the criticism he desired to make—that, animated as everybody was by the modern spirit of hurry, progress, and looking ahead, the present and the future of Mohammedanism in India in a treatise of greater extent would have appealed to them immensely. He thought in dwelling longer on the past than on the present and the future, the author was displaying a very common characteristic of his co-religionists. He would not say that it was a failing, but there was no doubt that the Muslim of India was too fond of looking back to the past. He needed to look more ahead, a fact which he thought the author fully recognised; but he (the Chairman) wished for the sake of those who read the paper afterwards that that point had been more emphasised in the paper. Next, he thought that anyone who read the paper in the future would carry away an undue impression of the ability and the intellectual powers of Mohammedans as a whole in India. No one was more ready to admit than he was the existence of brilliant exceptions in the persons of able Mohammedans in all classes of life, but it would be a wrong impression if anyone thought that the proportion of Mohammedans who were progressive, intellectual, and distinguished was a large one compared with the proportion of other communities. That was fully admitted by the leaders of Mohammedan reform in India. He remembered that Mr. Justice Tyabji, who presided at the Educational Conference in Bombay in 1903, made a very brilliant, candid and courageous address laying great emphasis on that point. He said that "in every department of life, whether it be in the public service or in the liberal professions, the numbers of Mohammedans who

were distinguished civil servants, doctors, engineers, or lawyers, was a mere handful compared to the numbers of those of other communities." He went on to say that the Government had been impartial and fair, and that the backwardness of Mohammedans, which he so fully admitted, was due to their religious and literary prejudices, and to the absence of female education. The author had mentioned so many interesting points connected with the capable Mohammedan ladies, of whom he was most rightly and justly proud, that he thought the audience would go away with the impression that the successors of the Begams, of whom he had told so many stories, the Mohammedan ladies of the present day in India, were a great deal more cultured and capable than they really were. There was a brilliant exception to which the author referred in the person of H.H. the Begam of Bhopal; but he did not think there were many poets, writers, or critics of Holy Writ among Mohammedan ladies who could be at all considered as belonging to the first rank. At the Conference to which he had referred, H.H. the Aga Khan made some remarks, which were also characterised by frankness and courage, and which were of so much importance in view of what had for some time past been the attitude of Mohammedans in India that he had looked them up and made a note of them. His Highness said:—"Providence has given us a Government that guarantees justice, intellectual and religious liberty, personal freedom—a Government that gives a clear field and no favour, that constantly by its own acts reminds us that fitness is the only test, and that for the fit there are no obstacles." That was the attitude of the men of light and leading among Mohammedans in India, and that was the attitude of the author of the paper. Unlike the great majority of his co-religionists, Mr. Yusuf-Ali made no complaint that the Government had been partial, and he had not asked for preferential treatment. Indeed, one of the sentences in the paper which pleased him most was the allusion to the "treacherous sands of preferential treatment." One of the most encouraging things at the present time was that the leading Mohammedans, under the guidance of enlightened and brilliant men of strong character, like the two whose words he had just quoted, were giving up the idea that preferential treatment in the public service would prove their salvation, or be of advantage to them. It was perfectly obvious that a few more billets in the Government service could not possibly be of any appreciable advantage to so vast a community as 62 million people, but yet the humbler Mohammedans pathetically pinned their faith on that hope. It was a comfort that that idea was slowly being given up, and making way for more sensible views of the situation, and to a conviction that in self-help and self-reliance lay the hope for Mohammedanism in the future. During the past five years he had had a good deal to do with Mohammedans. They had come to him with petitions and addresses to which he had to reply, and the burden of them all was "Give us more posts in the Government Service." Those representations were not drafted or instigated by the leading men. With regard to these he desired to say, without any intention of paying a compliment to the author, that the Indian Mohammedans had always had the greatest attraction for him. That attraction was due, not only to their manliness, to their courtly manners, to a sense that they inherited a deep-seated love of learning of an Oriental character, but also to the certainty he entertained of their feelings of loyalty and patriotism. The author concluded his address by saying:—"If I were asked to make a banner for this peaceful campaign of progress, I should inscribe on it the following mottoes:—"Staunch loyalty to our Sovereign; patriotism for our country; friendliness to all our neighbours; and, the sum and substance of them all, absolute truth to ourselves." He thought the Mohammedans of India were true to everyone of those mottoes except the last—they lacked absolute truth to themselves. That could only come from and through themselves; the Government could not help them with regard to that. He sympathised very much with the author when he dwelt on the past of Mohammedanism, because he thought the past was the subject of which Mohammedans had great cause to be proud. There was not only the fact that the Moghals laid the foundations of that British dominion in India of which we are all so proud, that they had laid to a great extent the foundations of that system which England is now carrying on, but also that they had a wonderful history of civilisation and enlightenment to which they could well look back. It was not often remembered by this country that the Mohammedans were the pioneers of civilisation in Europe. All the first great truths regarding mathematics, astronomy, and medicine came from the Arabs who were of the faith of Islam. In the old days the zeal for learning was so great that it was related of one Khalif of Baghdad that he prepared to make war on the Roman Emperor for no other reason than that of compelling him to send to Baghdad a famous mathematician of his court. One could trace back to all that natural and just pride of their ancient learning, power, and enlightenment, the reason for one of the present failings of Mohammedans—they had clung to the old system of education. At the commencement of the British rule they were too prone to neglect Western education, and thus allowed the Hindus to get a start of them in the race. To put the matter quite plainly, in the baldest language, the young Mohammedan was taught the Koran in the school in the old-fashioned way, *i.e.*, he was taught to commit the Koran to memory for several years to the exclusion of his secular education, and, therefore, he was several years behind the young Hindu boy. The same process was going on with the individual as had gone on between the two races. He believed it was a fact, because it had been stated by the great Mohammedan

leaders in India, that Islam was not hostile to Eastern or Western education. The Prophet himself said, "seek knowledge even if it were in China." In the ancient Khaliphates of Baghdad and Spain, to which he had just referred, the works of the Greek and Roman philosophers were read side by side with the Koran, and the faith of Islam was not undermined or impaired in any way. The signs of the times, as the author said, were extremely hopeful. The great work of Sir Syed Ahmed Khan, which could not be over-estimated, was beginning to be appreciated. The Mohammedan educational conference was slowly but surely pursuing its propaganda, and recently a new development had been seen in the deputation to the Viceroy of the Mohammedan leaders of the whole of India. It was a very remarkable demonstration, from which the attitude of Mohammedans towards British rule and towards the question of their own progress was thoroughly patent. He thought it was a most encouraging episode, and one full of hope for the maintenance of a bond of cordiality between the British race and Mohammedans in India, and for the future of Mohammedans themselves. The author had given several charming anecdotes, and he personally would like to emulate his example by giving one also. Mr. Yusuf-Ali had referred at some length to the Wahabis, who might be roughly described as the Puritans and Protestants of Islam. In a sense they represented both those classes, and they were also Unitarians in so far as they were against polytheism. They objected to all gaiety and frivolity, just as Puritans did in old days. One thing they condemned most particularly was smoking; and *apropos* of that he found in Palgrave's book on Arabia a rather amusing anecdote. Palgrave narrated "that one Abd-ul Karim said to him, 'The first of the great sins is giving Divine honours to a creature.' 'Of course,' I replied, 'the enormity of such a thing is beyond all doubt. But if this be the first, there must be a second; but what is it?' 'Drinking the shameful' (the Arabic idiom for smoking tobacco) was the unhesitating answer. 'And murder and adultery and false witness?' I suggested. 'God is merciful and forgiving,' rejoined my friend; that is, these are little sins.'"

Sir WILLIAM LEE-WARNER, K.C.S.I., desired to add the special thanks of the Indian Committee to Mr. Yusuf-Ali for the successful lead he had given in a new departure. In previous years we had heard about Indian arts, finances, commerce, resources, and famines. The Indian Section was now beginning a course upon the people of India, and he hoped that the account of each of the main races would be given by one of that race. The author had not only given an interesting account of his own co-religionists; he had also contrived to show his devotion to his own people without a single word which could possibly offend any one of the other races. He (the speaker) professed himself a disciple of the Swadeshi movement, and the more he thought about the various qualities of the very different races and religions of India the more he felt what a vast resource India possessed in the sum total of their different qualities if only they could be turned to account for the good of their common country. How to utilise these resources of India's manhood for the common good, employing Christians, Hindus, Mohammedans, Parsis, Buddhists and others in the public service, was the great problem, and it could only be solved by knowledge and appreciation of the qualifications of each race. The Mohammedans had turned out great men in the past and there was no reason why they should not do so in the future. Perhaps the Government would be wise in altering some of its methods of selection, perhaps public competition was not the best means of recruitment. But certain it was that we must not let the national resources of India run to waste. We must enlist the best of all races in due proportion in the common work of the public service of that great Empire. He hoped that the paper which had been read and those which were to follow would suggest how this end could be attained.

Mr. AMEER ALI, C.I.E., said the subject of the paper was of especial interest to him, as he had traversed a good deal of the same ground, and it was interesting to notice how the salient features of the history of the Mohammedans of India struck the younger generations of his co-religionists. He thought the reader of the paper had rather lightly touched on the work of the Mohammedans in India. It was usually supposed that the Mohammedans came as conquerors, and long after their settlement introduced political institutions which had been of value to their successors in the work of Government, but the amount of help they had given to the development of civilisation in that country was not recognised. If the history of Mohammedan India was more carefully studied, it would be found that the Mohammedan savants, scholars, poets, and *littérateurs*, who came from the West to India, furthered to the utmost the civilisation of that country, and added to the civilisation of India which had come down from ancient times. He joined in the Chairman's friendly criticism of the paper that it dwelt too much on the past. Personally he had hoped to hear a good deal about the present condition and future prospects of the Mohammedans in India. He thought it was necessary to make a few observations on the question of the *wakf* institutions to which the author had referred. He had devoted some 400 pages of his work on Mohammedan law to the elucidation of the law of *wakfs*. Up to that time he was under the impression that it was English judges only who did not quite appreciate the abstract side of this branch of the Mussulman law, but he was sorry to find the learned reader of the paper felt a similar difficulty. If Mr. Yusuf-Ali would be good enough to explain to him the exact nature of his difficulty he should be very happy to offer such explanation as he could. In 1885 the Central National Mo-

hammedan Association of Calcutta, of which at the time he was secretary, represented to the Government of India that the Mohammedan *wakfs* all over the country, which included provisions for the advancement of education, were being wasted and misapplied. The Government of India moved the Government of Bengal to appoint a Commission for the purpose of investigating the matter. Three members belonging to the progressive section of the Mohammedan community, and three others from a different section, were appointed on the Commission, the Advocate-General of Bengal being the chairman. Unfortunately, the views expressed by the Commission were so divergent that the Government of India felt it difficult to grapple with the matter and dropped it, so that the endowments had gone on as usual, and nothing had been done. It was not the fault of the Mohammedan community; it was the fault, if he might say so with all deference, of the Government, which thought itself so bound to defer to what it considered orthodox views that nothing had been done for the protection of Mohammedan *wakfs*, or for their utilisation for the promotion of education. With all respect, he desired to say that the Mohammedans of India did not seek preferential treatment; they wanted fair and equitable treatment. They felt that within the last few years there had been such a change in the policy of public affairs that they did not get the treatment to which they were entitled.

Mr. THEODORE MORISON (late Principal of the Mohammedan Anglo-Oriental College at Aligarh) said the paper had suggested to him that, in considering Mohammedan history, the author had made it quite clear that Mohammedans had had a tradition of culture which was entirely independent and their own. Even during the time that they had lived in India, although no doubt they had been influenced by their surroundings, that intellectual tradition of culture had been independent. He did not wish to enter upon the very debatable and thorny question of whether the Mohammedans might be considered a nationality of their own in India, but the fact that they had an intellectual tradition constituted a strong argument for what the most enlightened Mohammedans of the present day were asking for, namely, a University of their own. He was aware that was not the opinion of their late University Commission, but it was his own view; in this he was entirely in sympathy with the Mohammedan community. He presumed the author had not referred to that question because it was a debatable one. Mohammedans had in their own language words which would have been extremely useful in the educational broils in which England was now engaged. They had two distinct words for intellectual training and the discipline of character. There was, unfortunately, no word in English to distinguish intellectual instruction from the discipline of character except those rather clumsy and lengthy words. The Mohammedans expressed the distinction by simply using two words: *ta'lim*, to imply intellectual instruction, and *tarbiyat*, to mean discipline of character—the conception being that the training of character was an integral part of education and could not be divorced from it. There was a purely secular education in India, and therefore the training of character took no part in it, because it was felt that, if conduct was influenced, the dangerous ground of religion was entrenched upon. Mohammedans accordingly contended that they should be allowed to carry on the intellectual tradition they had hitherto possessed, and give to their children an education which would not only be educational but include the training of character. One of the present ideals of the Mohammedans was, as he had said, that they should be allowed to have a university of their own, which, of course, was not intended to absorb the whole of the educational institutes of the country at which Mohammedans were at present educated. The Mohammedan leaders, at least, recognised that a university such as they contemplated could only be for a very small number. The great majority of Mohammedans would have to attend local colleges, what might be called "bread and butter" colleges, which students attended simply for the sake of the advantages the training conferred upon them for their work in after life. He knew that view of education had been a good deal sneered at recently in India. To put it frankly, the great majority of people who went to universities, either in England or in Germany, did so because it gave them greater chances and advantages in the struggle for existence; but what the Mohammedan leaders demanded, with, he thought, absolute truth, was that they should have in their community a small number of highly educated men, of scholars, who would increase the reach of Mohammedan thought and diffuse high ideals throughout their community. It was their belief that they might create in one place a sort of intellectual capital for Islam in India, and that was their ideal in wishing for a Mohammedan university.

Sir RAYMOND WEST, K.C.I.E., after joining in the chorus of thanks which had been expressed to the author for his excellent paper, said that matters of Mohammedan history admitted, like the history of other nations and communities, of various views. For instance, the views held in England with regard to English history varied from those entertained on it in France or Germany. He, therefore, thought it was no discourtesy to the paper, the admirable spirit of which he thoroughly recognised, to say it was quite possible to have somewhat different views on some portions of Mohammedan history from those the author had put forth. He invited his hearers to look into the subject for themselves. There was a great deal in Mohammedan history which was worthy of admiration and respect. He was quite certain that the want of respect for Mohammedan feeling, traditions and men, of which there was at least a veiled complaint in the paper, did not really exist; it

was merely a thing conjured up by the over-sensitive imagination of the members of the Mohammedan community. He had had a good deal to do with Mohammedans in his time, both in India and Egypt; and no men in the world with whom he had had to deal had appealed to him more in point of manners and bearing than the Mohammedans with whom he had been brought in contact. They were grave, courteous, modest, and manly in their bearing, and in every way calculated to win the respect and admiration of Englishmen. He believed that, if the English gentlemen who had rendered service to the Government in India were consulted, it would be found that no people stood higher in their estimation, or commanded their respect more than the Mohammedan people; and he trusted that if the author had any lurking suspicion that there was still a want of respect on the part of English people for the traditions of his community, he would put it away from him at once and for ever. The history of the past, however, was of less importance than the position of Mohammedans in the present. He thought the position of Mohammedans in India at present, did present certain difficulties, but they were being fairly faced by the Government; and he had no doubt that a remedy would be found by co-operation between the Government and the most intelligent leaders of the Mohammedan community, such as those who had lately been expressing their views, and also by the influence of such men as the author himself. Mr. Yusuf-Ali had spoken of the necessity of organisation. He thought organisation was even less necessary amongst the Mohammedan community than the formation of a new set of theories and ideals. A great deal of wealth, social and intellectual, might be drawn from their ancient literature, which would be of infinite advantage, as those were the stores from which they ought to draw the principles which were most calculated to benefit them in the future because they were of natural growth. Things which were admittedly exotic seldom took root so thoroughly as those drawn from the stores of one's own history and literature. For instance, Mohammedan law gained no place amongst the Mohammedan community until men of genius contrived to draw out from the then existing sacred literature of the Mohammedans the basis for a structure of Mohammedan law, which had governed the people and been the most potent means of swaying their minds from that period down to the present. He, therefore, thought the author, and other members of the Mohammedan community, should form amongst themselves a set of ideals and theories for the advancement of their people adapted to present needs, but drawn from the riches of their own literature, feeling certain that truth based on those eternal foundations would work itself out to the ultimate benefit of their community.

Dr. Seid Abdul Majid agreed with the author that there was a want of organisation among Mohammedans for placing their grievances and demands before the Government, not that he advocated any proceedings which would detract from the loyalty which Mohammedans observed towards the Government, or be unfriendly to other communities. A centralised Government, such as the Government of India, should study the wants of the people; but, unfortunately, in India the head of the Government was changed every five years, so that just when the Viceroy was beginning to appreciate the wants of the people, and follow out a proper policy, he was recalled. He disagreed with the Chairman's view that Mohammedans were antiquated. The smallness of the number in the Government service was due to the want of interest in the Mohammedans on the part of the Government officials, and not to their want of ability, as had been pointed out in the Address presented to the Viceroy, at Simla, on October 1st. An Address was presented to the Chairman, by the Mohammedans, when he was leaving Madras, and, in reply, his lordship said that the Mohammedans were lacking in pushfulness; but personally he maintained it was the duty of the Government to push them forward. Further, as Mr. Morison had pointed out, Mohammedans required a University which would mould the character of their young men, their ethical needs being entirely different from those of the other races of India. Although the Government, so far, had not supported their appeal, he trusted it would be again considered in the friendliest manner.

On the motion of the Chairman, a hearty vote of thanks was accorded to Mr. Yusuf-Ali for his exceedingly interesting paper.

Mr. J. D. Anderson, late I.C.S., writes:—It seems to me that Mr. Yusuf-Ali's admirable paper provides mattter for thought to all who are interested in India. It brings out, incidentally, how different are our problems from those of other Mohammedan countries. Of the Turkish Empire I will not venture to speak. In a purely Mussulman country the regeneration of the administration is in the hands of the leaders of the people, and European example and advice is probably not of much use. In Tunisia and Algeria the problem is chiefly economical. These countries are being overrun with hundreds of thousands of Christian immigrants from Sicily, Malta, and the Balearic Isles, in search of land to cultivate and of manual labour. The Mohammedans of French Africa are pressing their Government to protect them against the industrial competition of men who are not only aliens but not even French subjects. In Egypt, again, is a different problem. I suppose such men as Mustapha Kamel Pasha, and such newspapers as *El Lewa*, do not aim at making Cairo another such place as Stamboul. I suppose they desire an independent but Europeanised Egypt. In India, as Mr. Yusuf-Ali shows, the problem is

quite different again. There the Mussalmans are not only in a minority, but, in many provinces, are very scattered. There was a time when it seemed as if they were content to dwell as foreigners in India, since they could not have their old position of undisputed rulers of the country; but, as the paper shows, Islam is waking up to the fact that it can claim, if not the old monopoly of rule, yet the share in the administration which is due, not merely to its numbers, but to the energy, the culture, the independence and the honest purpose of enlightened Mussulmans. Now, one of the peculiarities (as has often been noticed) of Hinduism is that, though it is an exclusive religion and makes no direct converts, it is curiously tolerant. The propagandist religions "of the Book" have always had some difficulty in being tolerant, in "rendering to Cæsar the things that are Cæsar's." It was largely Indian dominion that taught Englishmen the lesson that administration in a country where there are many religions must necessarily be (in the modern phrase) "undenominational," and that the government of such a country must be purely secular. If the Mohammedans of India can learn this lesson, they have a great future before them, and especially those who, like the author, possess a high official position The Mussulman in India has to assert his rights as a British subject, has to show, as he can easily show, that to be a Mohammedan by creed is not, as it has sometimes been, a disadvantage but an advantage. History has shown us that Mussulmans can be as tolerant as Akbar himself, as tolerant as the best Anglo-Indian administrators have always been. They will have to assert themselves in secular matters, and hold their own with their Hindu fellow-citizens. But they will have to do this in a spirit of courtesy and tolerance, and not of aggressive superiority or exclusiveness. They must demand a fair field for their energies, commercial, social and political, and must show that the races who once ruled India can hold their own in the modern struggle for life. To do this, they must hold to and assert the doctrine that administration in a mixed country like India must be purely secular, and that religious tests of all sorts must be excluded from public business. They must no longer stand aloof from politics and government, and must claim to be consulted, not as Mussulmans, but as natives of India, whose culture, intelligence, and sincerity of purpose give them a peculiar claim to be consulted. And if all this is true of the Indian Mussulmans, it is equally true of the Indian Christians, many of whom are in a worse state than any of the followers of Islam. They have to show that it is no more a disadvantage, in the social and political sphere, to be a Christian than to be a Hindu or a Parsi, and to show this, not by asserting the superiority of Christians as such, but by proving that the profession of Christianity is not incompatible with civic virtues, business habits and political wisdom. I think all this is more or less implied in the admirable and suggestive paper, the optimistic spirit of which renders it delightful reading to all who believe that the present agitations in India will result in a better understanding between all classes of the King-Emperor's loyal subjects in a country where loyalty is traditional.

Mr. YUSUF-ALI writes:—

As there was no time at the meeting to reply to the points raised in the discussion, I submit the following remarks for insertion in the *Journal*:—

I am under a deep obligation to the distinguished speakers who have joined in the discussion, and to the friendly audience which has given so kind a reception to the subject of the paper. My object was to bring forward a few facts about Indian Mohammedans in as interesting a manner as possible, and to avoid all controversial topics. Had I been speaking to an audience consisting chiefly of Indian Muslims, I should no doubt have felt it my duty to adopt a different mode of treatment. I should then have assumed much of the past, and insisted more on the present and the future of the internal affairs of the people. But in introducing the subject to a London audience, many of whom are probably unfamiliar with it, it seemed to me best to lay before them a few of the undoubted facts of history, facts which continue to influence and shape our ideas at the present day, and will have a great deal to do with the unfolding of our future. It is on the same principle that when we make a new acquaintance, we want to know all that he has done in the realm of action or thought, for that is the surest key to his character, and will enable us to calculate what he is likely to do in a given set of circumstances. At the same time, I am at one with the noble Chairman in his advice to the Indian Mohammedans to look ahead rather than rest on their oars, and I welcome his words, and those of Mr. Ameer Ali as likely to carry much weight and authority with the Indian Muslims.

To Sir William Lee-Warner I owe a debt of gratitude in many ways—not the least for the interesting announcement which he has made about the new departure initiated by the Indian Section of the Society of Arts, over which he so worthily presides. A most encouraging sign of the times is the interest now taken in Indian affairs in the capital of the British Empire. It is possible to hear more papers by the highest authorities on Indian topics in London during the season, than even in Calcutta or Bombay.

On the subject of *wakfs*, the limitation of space and time have not permitted more than the briefest allusion in the paper. I had hoped for a more extended review of that difficult question from Mr. Ameer Ali, who can speak with acknowledged authority. He has not only written about it and taken the action which he alluded to in connection with the Central Mohammedan Association of Calcutta. His long judicial experience, and his share in the practical administration of the Mohsin Fund, would enable him to handle the subject with a

mastery of detail which must necessarily be wanting in mere abstract discussions. What I meant to suggest in the paper was that specific instances of Muslim *wakfs* in India should be taken, their history carefully traced, their original conditions examined, their present administration inquired into, and the influence of legal decisions favourably or adversely to the claims of individuals and communities impartially estimated. Each *wakf* should be treated on its own merits and examined in the minutest detail, and the conclusions should be based, not upon opinions, but upon hard, solid facts, which can be verified by the opponents of any measures which the collective sense of the community proposes after such examination. It seems to me futile to expect unanimity in the community on such a subject, but the treatment of the subject on the lines proposed would be able to carry conviction to all public-spirited minds, and when they speak with one voice, I have not the slightest doubt that the Government would be only too pleased to undertake legislation in a practical spirit.

We must recognise that there are three distinct sides to the question of *wakf*. First, there is the juristic question of the interpretation of the authorities, which are by no means unanimous. Recent rulings of the British courts are in conflict with the carefully reasoned opinions of men like Mr. Ameer Ali, whose views must command the highest respect, on the question of the validity of family settlements. On this side of the question there is a voluminous body of literature, which is reinforced by the demands of those whose chief idea is the conservation of ancient families. This brings me to the second side of the question—that which touches the interests of individuals and families. In many cases these interests are inextricably mixed up with bequests for "pious uses" properly so called, religious purposes, charitable purposes, and purposes of public utility such as educational institutions. To separate and distinguish these different objects is certainly most difficult and not always possible; and yet the task must be attempted if we are to save the most beneficent *wakfs* from the deluge which threatens to swallow up all because certain incidents have been attached to some, which the courts as at present constituted, hold to be inadmissible. Again the definition of "pious uses," "religion" as opposed to superstition, and "charity," as opposed to the nurture of pampered and glittering indolence, vary with the evolution of ideas in the public mind. It is necessary in every individual *wakf* to see what is directly of public benefit and what in the first instance only serves private ends. Save both if you can; but if not, at least save the public benefactions. The third and most important side of the question of *wakf* relates to those which deal with public purposes only. It will be found that many of these have been diverted to private uses, in other words misappropriated—or else applied to purposes other than those originally intended. In each individual case, as men of progress, we have to apply our best ideas to the solution of the difficulties; as practical men, we have to hold the balance even between the donors' wishes, private or vested interests, and public purposes pure and simple. In many cases it will be found that where public and private interests are mixed up, the private interests have been carefully watched by those whom they concerned, while the public interests have all lapsed through lack of organisation, and for want of a strong and healthy public opinion. We ought to create such an opinion, organise it, and make it audible. When a survey in detail, such as I am advocating, is carried out, we shall be able to see exactly our position with regard to *wakfs*, historically and prospectively, and there should be no difficulty in getting reasonable legislation passed in the public interests.

It is in inquiries and questions such as these that organisation is of the utmost value, but I agree with Sir Raymond West that, unless the organisation is vivified by ideals—strong, true, and honest—it would not help, nor give us those moral impulses which would carry us over difficulties. When I pleaded for greater respect for the history and traditions of the Indian Moslems, it was in no spirit of complaint, but rather in the hope and belief that more knowledge of each other among the different races who have to deal with India might lead to a better understanding and facilitate the work of Government on the one side, and peace and progress on the other. On that head, the assurances of Sir Raymond West are most valuable, and, considering his distinguished career in Egypt and India, have the greatest significance.

I am glad my friend Mr. Theodore Morison was able to bring forward the question of university education. As a controversial topic I could not discuss it, which was, perhaps, as well, as it brought out the interesting and original points which Mr. Morison has put before the meeting.

Mr. Abdul Majid has tried to defend the Mohammedans from the charge of being antiquated. I am not sure that it is such a heinous charge after all. In some quarters it may even be gloried in, if the only alternative was the maxim: "Get in politely if you can, but if not, get in anyhow."

There is only one point of view not represented in the discussion. I wish it had been possible for an enlightened Hindu or Parsi gentleman to have told us how this presentation of the Muslim case strikes his community. But perhaps that may yet come when the hopes and aspirations of those communities are brought forward before this Society.

GOOSEBERRY MILDEW.

The Board of Agriculture and Fisheries have received information that the American gooseberry mildew (*Spaerotheca mors-uvae*) has been discovered in more than one place in England, and as there is

reason to believe that the disease, in at least one case, is of some years standing, they think it desirable to warn all fruit-growers, nurserymen, gardeners, and other growers of gooseberries of the dangers involved. The disease, which is termed American owing to the extensive damage it has done in America, is of a very serious character, and has rendered the culture of gooseberries unprofitable and practically impossible wherever it has appeared.

The mildew generally becomes visible during the last half of May or the first half of June, when it appears in the form of "glistening frost-like spots" on the fruit on the lower part of the bush where there is usually dense shade. It then spreads to the leaves and tender shoots. In its earlier stages it has a cobwebby appearance, which soon becomes white and powdery from the development of the light conidial spores. Later in the season the leaves and other parts affected turn a rusty brown. The fungus prevents the berry from growing, and the fruit becomes worthless. All during the summer, therefore, the disease can easily be detected and the bushes can be dealt with according to the extent of the disease. But during the winter the disease remains dormant and will not spread from plant to plant. During this period, however, it can be conveyed from one district to another in bushes and stocks. It is clear that enormous and irreparable mischief may be done in this way, and it is the duty of all nurserymen to take precautions not only for their own sake but for the sake of the locality in which they live.

The Board of Agriculture and Fisheries, therefore, urge all nurserymen and market gardeners who intend to buy bushes or stocks of *Ribes aureum*, whether from abroad or from Ireland, or even from other growers in Great Britain, to observe the following precautions :—

(1) Only to purchase from those growers or dealers who are prepared to offer a guarantee that the plants they are selling are of their own growing, and that no case of American gooseberry mildew has ever appeared in their gardens, or in the immediate neighbourhood, and that the said plants have not been near any gooseberry plants recently brought on to the seller s premises.

(2) To plant such gooseberry bushes or stocks as they may buy or acquire from other premises than their own, in a special part of their nursery or garden at some distance from other gooseberry bushes.

(3) To destroy all plants found to be affected with the mildew, and to spray with Bordeaux mixture all others suspected of being infested with the object of destroying any external mycelium or adhering spores that may be present. This should be carried out during the period when the disease is dormant.

(4) To keep a careful watch on all gooseberry plants in the forthcoming spring for any signs of mildew, and to report any appearance suggestive of the disease to the Secretary of the Board of Agriculture and Fisheries—4, Whitehall-place, London, S.W.—immediately it is detected.

(5) To assist the Board in discovering any unreported cases of the infestation during the past summer.

There is at present no law dealing with the eradication of the pests of fruit trees in this country, but the Board believe that the American gooseberry mildew has not spread very far as yet, and that it depends very largely on the action of the fruit growers, nurserymen and market gardeners whether its further development can be prevented.

THE USES OF COTTON SEED.

At a recent meeting of the Cotton Seed Crushers' Association, at Atalanta, Georgia, some interesting facts were brought out in regard to the uses of cotton seed, both for home and export purposes. One of the speakers, who was in early life a cotton grower, said that he remembered well when cotton seed was burnt to get rid of it, but last year there were 4,500,000 tons of cotton seed bought from the planters in the Southern States of America, and the sum of £15,000,000 paid to them, thus adding practically 25 per cent. to the value in that way of the cotton crop. This has been brought about principally through the cotton-seed oil industry. There are probabilities of still further developments in the use of cotton seed, which will increase the value of the product. Professor J. H. Connell, in speaking of cotton-seed meal as human food, showed some biscuits and cakes made from a combination of cotton-seed meal and wheat flour. They were pronounced as delicate and tasty as any product of the flour barrel by the members of the convention who were given an opportunity to partake of them. Another use of seed is that for fertilisers, in the shape of meal. The use of the raw seed to enrich the land was pronounced a waste when the meal can be used to much better financial advantage. Professor Connell said that within a short time he believed that cotton-seed crushers would be able to announce an actual discovery of 4,500,000 tons of a new product fit for human consumption. He stated that he had used cotton oil as a cooking fat for six months, and that it was equal in all respects for cooking purposes to the best lard. By an invention of comparatively recent times cotton oil is freed from the old impurities which gave it a rank odour. So-called olive oil, which reaches America from Southern Europe, carries a large percentage of cotton-seed oil. Cotton-seed meal is used in making biscuits, pancakes, gingerbread, cakes of all kinds, and for various other purposes. The United States Department of Agriculture says that cotton-seed oil "is worth, for food purposes for animals, about double the value of timothy hay, and cotton-seed meal, for the same purpose, is worth three and a third times as much as corn meal." About £6,000,000 worth of cotton-seed oil is exported, and that is only one-third of the product. Fifteen years ago 500,000 barrels of cotton-seed oil were made, which number was increased to over 3,000,000 barrels for the past season.

HOME INDUSTRIES.

Workmen and Co-operation.—In the year 1883 the co-partnership productive societies established by the workmen themselves, numbered 15, with an aggregate capital of £103,000; to-day they are 124, with a capital of £1,819,000, and a turnover of nearly £3,700,000 per annum, the annual aggregate profit being £190,000. These figures show how great has been the progress of these societies in recent years. The same may be said in somewhat lesser degree of co-partnership and profit-sharing by employees in companies and private firms. The annual report of the Labour Co-partnership Association gives some striking figures in support of this statement. For the year ended June last, five gas companies, the South Metropolitan, the Commercial, the South Suburban, the Newport, and the Chester, allotted £53,250 amongst 7,200 workmen as their share of profits over and above the ordinary standard wages. All told these five companies have divided £369,500 among their workpeople, who now have £368,500 invested in shares, or deposited with the companies. Moreover two of these companies have included their workmen in their directorate, the South Metropolitan Company having three representatives of the men on its board, and the Commercial four.

Cotton Spinning Profits.—1906 was a profitable year for spinners, but not quite so profitable as 1905. Taking 90 companies, with a total capital employed of £5,102,360, the average profit in 1905 was £7,701; in 1906, £6,555, or a profit per centage in 1906 of £17 1s. 4d., as against £19 3s. 6d. in 1905. But whilst the profit earned in 1905 was substantially larger than in 1906, the average dividend paid in 1906 was 9⅜ per cent. against 7 per cent. in 1905, the explanation being the large number of adverse balances in the earlier year. Notwithstanding the higher dividends paid in 1906, the credit balances and reserves now stand at £642,306 as against £400,004 last year. The profits earned are much larger than the dividends distributed would suggest. The profits of 1905 were 19 per cent.; in 1906, taking the 90 companies named, they work out to 17 per cent. Moreover, this profit was made by companies which are users of the oldest type of plant, and issue full detailed accounts of the capital employed. But there are many other companies which do not announce the profits earned. These companies paid out dividends and bonuses averaging 13 per cent. against 9⅝ per cent. paid by them in 1905. The present margin between raw cotton and the produce of yarn, is more satisfactory than it was at the beginning of 1906, and the profits and dividends expected in the immediate future promise to create a fresh record in the history of cotton spinning. During 1906 a large number of new companies were formed for the erection of up-to-date mills for the consumption of American and Egyptian cotton, and the producing capacity of these mills is estimated at not less than 2,000,000 spindles. But it takes more than a year to build and equip a mill, so that the markets have not as yet felt the full force of the increase of plant. The present prospects of the cotton crop of the world for 1907 are good, and the indications point to another good year. But the outlook is not altogether without clouds. Should the present activity in trade continue it may be expected that there will be an agitation for increased wages; apprehension is being expressed as to the effect of the large number of new mills that have been erected; and there is even scarcity of labour to work the existing machinery. It may be noted that, taking the last 23 years, aggregate profits were made in 17 years of £3,972,870, and losses in six years of £266,766, leaving a net profit earned of £3,706,104, or an average of a little over 7 per cent. Last year's average dividend of 9⅜ was the highest, the next highest being 7 1-16 in 1901.

Railway Companies and the Public.—The Report of the Board of Trade upon the cases arising in 1904-5, in which it has acted as mediator between railway companies and their customers, tends to show that the right of appeal to the Board of Trade, given to the public by the Act of 1888, is valuable. This Act authorises and requires the Board to investigate complaints, and to call upon the railway companies concerned for an explanation, but does not give it the power to enforce its decision. If the Board cannot effect an amicable settlement, all it can do is to report to Parliament, "with such observations as it shall think fit." The practical result of that Report is not immediate, but it may influence after-legislation. During the two years covered by the Report the Board took action upon 146 complaints, most of them touching high or disproportionate rates, damage sustained, or alterations in the companies' regulations. In many cases official attempts at reconciliation were unnecessary, as the companies, upon being made acquainted with the grievances, satisfied the complaints. The Report says that in most years nearly half the cases inquired into are settled "more or less to the satisfaction of the complainants", who, it may be presumed, owe their redress to the Board. In the remaining cases either no arrangement can be arrived at, or arbitration decides that there is no appreciable grievance.

The Cycle and Motor Industry.—The past year has been a remarkable one in the history of these industries. The motor industry has enjoyed unprecedented prosperity. One company has made a profit in the year of £213,000, and after paying a 20 per cent. dividend, carried £120,000 to reserve, and £48,000 forward. Another made a profit of £106,000, and a third of £75,000. The sales of the leading companies at the shows were a record, and two of the companies have orders on hand that will keep them engaged throughout the present year. One firm has intimated that it cannot guarantee delivery before February, 1908, and a very big order for motor omnibuses has been going a-begging owing

to plethora of work already contracted for. As a result, there is no diminution in the cost of these vehicles, and it is impossible to foresee when the motor-manufacturing companies will have the incentive supplied by diminishing orders to produce vehicles at a price more in conformity with cost. On the other hand, there has been great reduction in the cost of cycles, tyres, and tubes, and the introdnction of the long credit system, both changes intended, of course, to attract orders. Although the cycle trade is not in the exceptional position of the motor industry, it has had a very prosperous year, and its turnover has exceeded even that of the abnormal year, 1895. The total output of cycles has reached nearly to a million of machines, and the exports represent in cycles and accessories about half a million sterling, the exports of motors, and motor parts for the year being nearly three quarters of a million. It is to be noted, however, that there is still a very large import of motor parts. The tube branch of the trade has not shared in the prosperity of the cycle trade. Over-production, and excessive rate cutting have led to heavy losses the largest of the tube companies having found it necessary to go into liquidation. The tyre branch has been more successful, and it is anticipated that the present year will be a period of great activity. Some of the cycle companies propose still further to reduce prices, more especially the cost of the higher grades, hoping to find ample compensation in increased output. It is to be regretted that the abnormal demand for motor-cars of different kinds must postpone indefinitely the reduction in cost which is imperative before there can be any general use of the motor outside omnibuses and tram-cars.

Poultry Farming.—There will be general agreement with Mr. Austen Chamberlain in his regret that cottagers do not more generally keep poultry, and so attract to themselves much of the £3,000,000 that now goes to the foreigner every year for eggs. Not only profit but pleasure can be derived from keeping fowls, and most villagers have room enough to keep them if they wish to do so. The successful rearing and keeping of poultry requires intelligence and unremitting attention, but nothing beyond the capacity of the ordinary villager.

The Coal Industry.—1906 was a very favourable year for coal owners. Unlike the iron and steel industries, which owe the exceptional prosperity of the year to the export demand, the home consumption of coal has greatly increased. The statistics for the full year are not as yet complete, but for the eleven months ended November 30th the exports of coal, coke, and patent fuel, were eight millions in excess of the corresponding period of 1905, and probably the gain for the year will be close upon nine millions. And so with the consumption of coal in the United Kingdom. In 1905 it was 169,017,000 tons, in 1906 it was some millions larger. The total output of coal in the earlier year was 236,129,000 tons, in 1906 it was between five and six millions in excess of those figures. In South Wales the best Cardiff steam coal has gone up to 17s. per ton, and best Monmouthshire coal to 15s. 6d. In Newcastle best Northumbrian steam coal has advanced to 12s. 6d. per ton, and Durham unscreened to 11s. per ton, whilst in Scotland prices have increased in similar degree, and the collieries are finding it difficult to keep pace with the demand. The outlook for the new year is exceptionally promising from the coal masters' point of view, for the demand continues to grow and the threatened labour troubles have disappeared. It is true that in the North of England the miners have given notice to terminate the Conciliation Board, but there is no difficulty as yet as to wages. In the Midlands the Conciliation Board for the federated area has been renewed for three years as from January 1, subject to the right to terminate the agreement by a six months' notice "in the event of any compulsory limitation of the hours of underground labour." The Scotch Conciliation Board has also brought about a settlement between the Scotch coal-masters and miners due to some concessions on the part of the coalowners which give the men an immediate advance equivalent to about 3d. per day. These arrangements point to an improved and improving condition of the trade just as the successful refusal of the shipbuilders in Scotland to concede the demands of the men on strike, and the unconditional surrender of the strikers, indicated the opposite in the shipbuilding industry.

CORRESPONDENCE.

FRUIT GROWING AND BIRD PROTECTION.

I read with much interest Mr. Hooper's paper on "Fruit Growing and Bird Protection," but it seemed to me that, both in that and the subsequent discussion, one of the most serious injuries caused by birds was too lightly dealt with. I refer to the ruin caused to pears generally, and to some of the choicer apples, by the growing habit of some of the tits, notably the tomtit, of pecking a hole in the fruit long before it is ripe, close to the stalk. This lets in water, flies, wasps, &c., and every fruit so pecked is irretrievably ruined. I have seen a fine crop of the pear *Doyenné du Comice* destroyed, with the exception of perhaps half-a-dozen, in this manner, and every year the habit seems to increase, so that it is becoming most difficult to save any choice pears at all. The mischief is done here long before sunflowers are ripe for seed, so that they would be no protection. What seems to be needed is some artificial protection, such as a small wire cap, to hinder the birds from getting near the stalk of the fruit, and I have already one in hand for trial next summer. If this fails, the only resource is to destroy the tits, or get no pears.

LOWTHER BRIDGER.

Old Manor-house, Walton-on-Thames,
29th December, 1906.

OBJECTIONS TO THE COMPULSORY INTRODUCTION OF THE METRIC SYSTEM.

I have read with interest Sir C. M. Watson's paper against the introduction of the metrical system into England, as it is always instructive to hear the arguments of one's opponents. I would not trouble you with this letter, however, were it not that I have seen no correction of the mis-statement made in including Spain in the countries using principally native measures. This is not so. The metrical system is the only recognised basis of weights and measures, and it is used universally except in a few out-of-the-way country places.

As regards its adoption, I do not think anyone who has not lived and worked in a country using the metrical system can be qualified to express an opinion on such an important matter. All the English engineers I have known who have worked for any length of time in Spain recognise its advantages, and would not, I think, go back to our complicated English weights and measures for choice. It requires an equal knowledge of both systems to say which is the better, and the majority of the opponents of the metrical system only seem to know it in theory.

It is also incorrect to state that the division of the circle into 400 grades has never been adopted. Hundreds of engineers use tacheometers so divided, and, moreover, the greater part of these are made in England. For rapid reading, as with tacheometrical surveying, the centesimal division is much more convenient, and has the additional advantage of lending itself to calculation with the slide rule. For astronomical purposes I have also used it, and have found no difficulty when using the suitable logarithmic tables and astronomical data.

My only object in writing has been to draw attention to the above facts which should not be allowed to pass uncorrected. As to the adoption of the metrical sytem, I am fully convinced it will ultimately force itself upon England without compulsory legislation, but this desirable attainment might be expedited if the State would adopt it for official purposes (such as contracts, &c.), and include it as obligatory in all school programmes. In a couple of generations the old methods would disappear of themselves.

GUSTAVE GILLMAN.

Aguilas, Prov. de Murcia, Spain.
December 28th, 1906.

OBITUARY.

LADY BURDETT-COUTTS. — Angela Georgina Baroness Burdett-Coutts who died on Sunday morning, 30th ult., was one of the oldest members of the Society of Arts, having been elected in 1848. She was proposed for election by Michael Faraday. Miss Burdett was the youngest daughter of Sir Francis Burdett by the daughter of Thomas Coutts, the founder of the famous bank which bears his name. Coutt's widow (then Duchess of St. Albans), who died in 1837, left the great wealth she had received from her husband to his granddaughter, who was then only three and twenty years of age. From that time to the present she was a prominent figure in the philanthropic world, and one of the first to adopt a systematic and catholic system in the distribution of her charities. The record of her good deeds is a long and brilliant one, but as it is fully set out in the obituaries of the public press it is not necessary to repeat it here, suffice it to say that she founded and endowed numerous public institutions for religious, benevolent, and philanthropic purposes, including bishoprics in Adelaide, British Columbia, and Cape Town, the church and schools of St. Stephen's, Westminster, and St. Stephen's Church, Carlisle, model lodging-houses in Bethnal Green, Columbia Market, and Westminster Technical Institute. In May, 1871, Queen Victoria conferred a peerage upon Miss Burdett-Coutts, and in July, 1872, she received the freedom of the City of London, the only lady who had ever received that distinction.

Lady Burdett-Coutts took much interest in the department of women's work at the Chicago Exhibition, and H.R.H. the late Duchess of Teck writing to the committee said: "Great as have been the intrinsic benefits that the Baroness has conferred on others, the most signal of all has been the power of example—an incalculable quantity which no record of events can measure."

NOTES ON BOOKS.

THE COMPLETE PHOTOGRAPHER.—By R. Child Bayley. Methuen: London, W.C.

The number of books of instruction in photography is now so great, and the information they contain so complete, that there would appear small need for an addition to the list. Yet this handsome volume may fairly be said to justify its existence. The public for which it appears to be intended is a large one, consisting of the very numerous class who without much —or perhaps any—scientific knowledge, practising photography as an agreeable pastime, find themselves pleased with its results and interested in its processes. Such persons will find just what they want in Mr. Child Bayley's pages, full information about the apparatus, materials, and methods they are using, without the need of any recurrence to first principles, or any demand for a knowledge, even an elementary knowledge, of chemistry or physics. Anybody, merely aiming at results, and not seeking to know how those results are acquired, will find just what he wants, and probably all that he wants. First, the apparatus is described, the camera, in its various forms, and the lens. A sufficient explanation is given

of optical principles, and the various classes of lenses are described with sufficient detail to guide the amateur in his selection. Chapters follow on "Plates and Films,', "The Dark Room," "Exposure," "Development," "Intensification and Reduction." Next comes a special chapter on "The Hand Camera." Then the various printing methods are described—silver (P.O.P. and bromide), platinum, and carbon. There are chapters on enlarging and slide making, and on colour photography. Landscape photography, architectural photography, and portraiture have each their special chapter; and divers miscellaneous matter are fully treated. There is a final chapter on "Photography and the Printing Press." There are a large number of illustrations, excellent examples of modern work, but not in any way connected with the subject-matter.

Producer Gas. By J. Emerson Dowson and A. T. Larter. Longmans, Green and Co., London. 1906.

This book contains a very full account of the manufacture of Producer Gas, its use in gas-engines, and a history of the growth and progress of the invention. To a large extent it is an account of the work of one of the authors, Mr. Emerson Dowson, whose name has been so closely associated with the use of producer gas for the development of power. As is well known, the crude gas, known by this somewhat awkward name, was first used to any extent by the Brothers Siemens, and it is to Sir William Siemens that the chief application for such gas in the regenerative furnace is due. In 1878 Mr. Dowson endeavoured to improve the manufacture of the gas by purifying and cleaning it, so as to render it available for heating purposes in general factory and domestic work, the object being to provide a gas which would pass freely through pipes and taps without clogging them, the improvement being mainly effected by passing the material through scrubbers, and washing it in the usual way. This treatment of the gas naturally eliminated some of its constituents which were useful for heating purposes, and the gas was in any case much weaker than the ordinary coal gas used for lighting purposes, which was applied in the first instance to the driving of gas-engines. At the same time its much greater cheapness offered many advantages, and Mr. Dowson set himself to manufacture a gas suitable for gas-engine work. His first paper was read in 1881 at the York Meeting of the British Association, where a 3 horse-power Otto engine was shown working with producer gas. In the same year an engine was shown at the Paris Electrical Exhibition. In the following year he read a paper (which received the Society's medal) before the Society of Arts. At that time there is believed to have been no gas-engine working which developed more than about 12 horse-power. For some time the difficulties in the way, and the fact that so long as small power engines were used, the cost of the fuel was not a very important consideration, stood in the way of the application of cheap gas to gas-engines. But as is well known the invention has been developed, both by the improvement of the gas itself and the adaptation of large gas-engines to its use, until there are at the present time many gas-engines of 1,500 and 2,000 horse-power working satisfactorily with producer, or blast furnace, gas; such gas is also used to a large extent for heating purposes.

The treatment of the whole subject appears to be very complete, and though, as above-mentioned, it is of necessity to a large extent a record of the work of a single inventor, this fact would hardly be realised by a reader of the book (could any such student of the subject exist), not previously familiar with Mr. Dowson's contributions to a very important development of the means of generating power for industrial purposes.

GENERAL NOTES.

The Price of Food in Germany.—Some interesting figures are given by Mr. Consul Buckmann as to the price of food in Germany, in his report upon the Trade and Agriculture of Bavaria (Cd. 2682) for 1905-6. In Munich the consumption of beer would seem to be falling rapidly, the consumption *per capita* in 1879 being 110 gallons per annum, and in 1904 only 69 gallons. Over the same period illegitimate births have fallen from 29·3 per cent. to 25 per cent. To what extent, if any, the growth of temperance has affected illegitimacy must be left to speculation. Mr. Buckmann says that there is good authority for stating that the keep of a German workman has increased in cost by 25 per cent. since 1904, meat alone having risen 35 per cent., whilst wages rose 10 per cent. only. That the general cost of living is increasing is proved by the fact that the military administration require now £4 per annum more than formerly for the maintenance of a soldier. The consumption of horseflesh continues to increase. At Bayreuth, for example, with a population of over 30,000, 239 horses were slaughtered in 1905, against 57 horses in 1902, and in Munich 2,893 against 2,592. In 1904, 81,312 horses and 1,177 dogs, and in 1905, 96,534 horses and 1,584 dogs were slaughtered for food in the German Empire. It is estimated, too, that in spite of a rapidly-growing population, cattle are growing fewer, the decrease in Bavaria amounting to 8·5 per cent. for the period from 1900 to 1904. In Germany there was for every 100 inhabitants 35·4 head of cattle in 1897, 33·7 head in 1900, and 32·2 head in 1904. The 20·8 sheep for 100 inhabitants in 1873 has now fallen to 13·1.

Cotton and Rubber in Sierra Leone.—The cultivation of cotton in Sierra Leone makes very slow progress. It is not systematically carried on by the natives. The species cultivated is indigenous, and

the lint obtained from it is not of good quality. In certain parts of the protectorate native cloth is manufactured for local use, and only sufficient cotton is grown to meet the needs of this industry. On the plantation of the British Cotton Growing Association, at Moyamba, says the Governor, in his report (Cd. 2684), 1,030 acres of land were under cultivation during the year, the experimental planting covered an average of 648 acres, and various types of seed were experimented with. The total quantity of cotton exported in 1905 was 31 tons, an increase of 18 tons over that of 1904. The greater part of this cotton was shipped by the Association, and 80 per cent. of it was purchased from the natives. The export of rubber shows large increase, exceeding by nearly 300 per cent. the amount shipped in 1904. Most of the increase was in "root rubber," which means rubber obtained by cutting up a vine at its roots into short lengths and boiling the cut fragments. Some fragments of the roots always remain in the soil, so that no danger exists of the plant becoming exterminated.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 16, 1907.—Adjourned Discussion on Mr. J. W. GORDON'S paper, on "Patent-law Reform." SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

JANUARY 23.—"The Isthmus of Panama." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company. SIR JOHN WOLFE-BARRY, K.C.B., F.R.S., will preside.

JANUARY 30.— "Apprenticeship." By JAMES PARSONS, M.A. SIR WILLIAM BOUSFIELD, M.A., LL.D. will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 24.—"The Bhils of Western India." By CAPTAIN E. BARNES, Indian Political Department. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

JANUARY 15.—"The Progress of the Uganda Protectorate." By GEORGE WILSON, C.B., Deputy Commissioner Uganda Protectorate. Colonel SIR FREDERICK D. LUGARD, K.C.M.G., C.B., D.S.O., will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

JANUARY 29.—"Artistic Treatment of the Exterior of the Pianoforte." By WILLIAM DALE, F.S.A. T. G. JACKSON, R.A., will preside.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

January 28; February 4, 11.

JUVENILE LECTURES.

Wednesday afternoon, January 9, 1907, at 5 o'clock.

"Perils and Adventures Underground." By BENNETT H. BROUGH. (Lecture II.)

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 7...Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. Walter F. Reid, "The Sixth International Congress of Applied Chemistry at Rome"

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. Warren Upham, "The San Francisco and Valparaiso Earthquakes and their Causes."

London Institution, Finsbury-circus, E.C., 5 p.m. Dr. H. Bradley, "English Place Names."

TUESDAY, JAN. 8...Royal Institution, Albemarle-street, W., 3 p.m. (Juvenile Lecture.) Mr. W. Duddell, "Signalling to a Distance from Primitive Man to Radiotelegraphy." (Lecture VI.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Auctioneers, 34, Russell-square, W.C., 7½ p.m. Mr. S. Jackson, "The Metric System."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Francis Fox, "The Simplon Tunnel."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Lecture on "The American Gooseberry Mildew."

WEDNESDAY, JAN. 9...SOCIETY OF ARTS, John-street, Adelphi, 5 p.m. (Juvenile Lecture.) Mr. Bennett Brough, "Perils and Adventures Underground." (Lecture II.)

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Ethological, 6½, Suffolk-street, Pall-mall, S.W., 8½ p.m. Dr. Macnamara, "The Effect of Elementary Education on English Character."

Geological, Burlington-house, W., 8 p.m.

Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. F. Victor Dickens, "The Beginning of Ancient Japanese Literature."

THURSDAY, JAN. 10...Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Mr. Alfred Powell, "Pottery."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. M. N. Drucquer, "International Aspect of Marriage and Divorce."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. James Swinburne, "New Incandescent Lamps."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, JAN. 11...Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. A. T. Weston, "The Balancing of Internal-Combustion Motors Applied to Marine Propulsion."

Astronomical, Burlington-house, 8 p.m.

Philological, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

TUESDAY, JANUARY 15, 3.30 p.m. (Colonial Section.) GEORGE WILSON, C.B., "The Progress of the Uganda Protectorate."

WEDNESDAY, JANUARY 16, 8 p.m. (Ordinary Meeting.) Adjourned Discussion on Mr. J. W. GORDON'S paper on "Patent Law Reform."

Further details of the Society's meetings will be found at the end of this number.

JUVENILE LECTURES.

On Wednesday evening, January 9th, Mr. Bennett H. Brough, delivered the second and last lecture of his course of Juvenile Lectures, on "Perils and Adventures Underground."

The lecturer commenced with a description of those dangers to which the miner was exposed, that had not received attention in the first lecture. Inundations, in which water had closed the only means of escape, had caused some fearful catastrophes, as at Bessèges, France, where the river burst into the mine when 139 men were at work. Similarly, on February 9th last, the flooding of the shaft at South Rose Deep mine, Transvaal, resulted in the death of 53 Kaffirs. In 1862, at the Hartley Colliery, 199 miners perished for want of means of escape, the shaft being blocked to a height of 400 feet from the bottom in consequence of the beam of the pumping engine breaking and falling down the shaft. Since then the law has compelled every mine to have two means of egress. In the Bessèges accident all were killed except five who were rescued after 13 days. A still more remarkable instance of rescue happened in Scotland in 1835, when owing to a fall of ground a miner 66 years of age was entombed and brought out alive after 23 days confinement without a particle of food. Similarly, Hicks, the Cornish miner, was rescued at Bakersfield, California, on December 21st last, after having been entombed for 13 days.

Serious accidents had also been caused by mine fires. One of the most appalling disasters of this kind was at a silver mine at Przibram in Bohemia. The fire in the shaft, the deepest in Europe, resulted in the death of 319 miners, the cause being a smouldering piece of lamp wick carelessly thrown aside which set fire to the shaft timber. The fatal accident at Snaefell lead mine, in the Isle of Man, in 1897, memorable for the heroic conduct of the late Sir Clement Le Neve Foster and Mr. G. J. Williams, H.M. Inspectors of Mines, was due to the effect of poisonous gases in connection with an underground fire. Accidents at quarries were of frequent occurrence, and statistics proved that the workers inside a quarry had a more dangerous occupation than the average collier or metal miner.

The lecturer then passed on to the subject of fire-damp, imagined by many to be the most formidable enemy that the miner had. From time to time there was news of some terrible colliery explosion, such as that at Wingate Grange Colliery on October 14 last, claiming scores of victims at once; but every day fatalities from falls of roof added up to a far higher total. Indeed, statistics showed that, while of every 100 deaths from accidents, 45 were due to falls of ground, 26 to miscellaneous accidents from fires, irruptions of water, explosives and machinery, 11 from surface accidents, and 6 from accidents in shafts; not more than 15 were due to explosions of fire-damp or coal-dust.

Experiments were shown, illustrating the properties of the dangerous gases met with in mines, and the principle of the safety lamp invented by Sir Humphry Davy, in 1816. Various types of safety lamp were shown, the latest being the Davis lamp, constructed to

be lighted electrically only when the lamp was closed, and provided with a lead plug to lock it. The various methods of lighting underground workings previous to the invention of the safety lamp were described, including the flint-mill invented by Spedding in 1775. The use of the safety-lamp in detecting the presence of explosive gases was pointed out, and the appliances used in the perilous duty of endeavouring to save the survivors after a colliery explosion were described. The most efficient apparatus shown was that devised by Mr. Meyer, which did good service at the Courrières colliery. There, on March 10 last, the most appalling catastrophe recorded in mining history occurred and caused the death of 1,101 men. The explosion was thought to have been due to coal-dust without fire-damp, and to have been caused by a blown-out shot. The heroic work done by the Prussian salvage corps, who at once hurried to the spot, had brought the subject of rescue appliances into great prominence. The author concluded by pointing out that the miner's calling, though a dangerous one, was not nearly so dangerous as that of men engaged on large engineering works, on railways and on merchant ships.

In illustration of the lecture, miners' safety lamps were lent by John Davis & Son, Ltd., Derby; the Evertrusty Shamrock rescue apparatus, as used at Courrières, by Wallach Brothers, 57, Gracechurch-street, E.C.; and models and diagrams by the Board of Education.

The CHAIRMAN (Sir Steuart Bayley, K.C.S.I.) proposed a hearty vote of thanks to Mr. Brough for his interesting course of lectures, which was carried unanimously.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ARTIFICIAL FERTILISERS: THEIR NATURE AND FUNCTION.

By A. D. HALL, M.A.,
Director of the Rothamsted Experimental Station, Lawes Agricultural Trust.

Lecture III.—Delivered December 3, 1906.

THE NITROGENOUS MANURES.

With the time at my disposal in these lectures, it would barely be possible to enumerate the properties of the nitrogenous manures, still less to discuss them with any fulness. I shall prefer, therefore, to bring forward certain points in the behaviour of these particular substances, which are not yet the common property of the text-books but which ought to be borne in mind in the application of these manures in practice.

We can begin by dividing the nitrogenous manures into two classes, the quick and the slow acting, in the first of which we have practically only nitrate of soda, sulphate of ammonia, cyanamide, and nitrate of lime. Our acquaintance with the two latter is too limited as yet to enable us to do more than predict that they will fall into line with sulphate of ammonia and nitrate of soda respectively. Nitrate of soda has now been in use in this country for something like seventy years, the Chilian deposits having been first discovered about the time of Darwin's voyage round the world in the *Beagle*. As nitre had long been known to possess great manurial value, the exportation of nitrate of soda to Europe was at once suggested, and in 1830 it appears that a trial shipment was made of 18,700 quintals of about 100 lb. each. By 1838, the date of the first volume of the "Journal of the Royal Agricultural Society," it was being tried experimentally by a good many landlords and farmers in this country. The production grew rapidly, and reached its maximum in 1899 when 1,344,550 tons were consumed; since then the output has declined a little owing to combination between the producers. At the present time the United Kingdom takes about one-twelfth of the total production, Belgium an equal share, France and the United States about one-sixth each, and Germany rather more than one-third of the whole. Opinions differ greatly as to the approaching exhaustion of the Chilian deposits; various estimates set their probable life at from twenty to forty years, but doubtless long before exhaustion sets in, the poorer grounds, now being neglected as containing less than the paying amount of nitrate, will be exploited, provided always that the artificial nitrate of lime does not render the whole industry unprofitable.

As to the origin of the nitrate of soda deposits there are two theories, to understand which some description of their mode of occurrence is necessary. The chief deposit lies in the province of Tarapaca, in Chile, on an elevated plain known as the Pampa of Tamarugal, about 3,000 feet above sea level, stretching for a breadth of some thirty or forty miles from the Corderillas on the eastward to a low range of foothills separating it from the sea

The climate is intensely dry, rain falling only every two or three years and then only in quantities which rapidly evaporate. The special nitrate-bearing deposit or *caliche* occurs a few feet below the surface, and is associated with earthy matters, gypsum, common salt, and sulphates of sodium and potassium. The generally accepted theory regards the plain as an ancient sea bed elevated by one of the volcanic movements common on that coast, and then desiccated. The nitrate of soda is set down to the oxidation of immense masses of seaweed present in the original sea, the salt of which has provided the necessary sodium base. The chief argument in support is the presence of a small amount of sodium iodate in the crude caliche, seaweed being known to contain iodine. But such a theory is as impossible on chemical grounds as it is untenable geologically. It involves in the first place an extravagant amount of seaweed, and our knowledge of the nitrification process is quite opposed to the idea that it would take place in a rapidly concentrating medium containing common salt. Nor have we any reason to suppose that salt would supply a base for nitrification, even if its hydrochloric acid could be turned out, the liberated acid would at once suspend the process. And again if the iodates are to be taken as indicating seaweed, why are not bromates also present in the caliche, since both bromine and iodine are associated in seaweed.

A much more probable theory is that the deposit represents the desiccated residues of fresh water streams flowing off the Corderillas, containing nitrates and other salts derived from old rich soils or rocks on the heights. The evaporation of such waters for a long period of progressive desiccation would result in the accumulation of the dissolved salts in the dry region over which the waters formerly spread when the rainfall was greater. The occurrence of iodine cannot be explained until more is known as to the amount of this element present in the waters and soils of the Corderillas.

The only other deposits of nitrate of soda which assume any economic importance are those which occur in Upper Egypt, where certain shale beds of Eocene age, outcropping on both sides of the Nile between Qena and Assouan, contain enough sodium nitrate to make the clay worth carriage as a manure, known locally as "tafla." Analyses of a series of these shales by Mr. F. Hughes shows an average of 6·7 per cent. of nitrate of soda associated with 10·1 per cent. of sodium chloride, and 5·4 per cent. of sodium sulphate. The material is disseminated throughout the whole bulk of the clay, and as this is not permeable to any extent by water the nitrate can hardly be due to infiltration, but must have been formed in situ; a conclusion which is much strengthened by the fact brought out by Mr. Hughes's analysis that small quantities of nitrogenous organic matter, ammonia and nitrites, are also present in the extract from the clay.

In all probability the nitrates in these shales represent the results of nitrification of a mass of organic matter originally contained in the deposit, but until further data have been accumulated as to the depth to which the nitrates extend, and their replacement or not by unoxidised organic nitrogen compounds at depths beyond the access of atmospheric oxygen, it is impossible to say whether we are dealing with recent or what might be termed fossil nitrification, or again whether there has been any concentration of the salts in the surface layer analysed.

In any case these Egyptian deposits give a clue to the possible origin of the Chile beds by the washing out similar strata (and the Corderillas consist of rocks of recent age) into a rainless area where the salts are accumulated by evaporation.

The two deposits present this common difficulty, that the deposit is nitrate of soda instead of nitrate of lime, the usual result of nitrification in soil; again both are associated with a preponderance of sulphates over chlorides, a fact which seems to put any marine origin out of the question. We are, however, dealing with typically arid conditions, and in all parts of the world sodium salts are characteristically abundant in the soils and rocks of areas of small rainfall; indeed, sodium carbonate is always found in such cases, and this would form the base for nitrification. At the same time, similar oxidising processes to those which give rise to nitrates would convert the sulphur of the organic matter to sulphates. But really to settle the problem of the origin of the Chile deposits of nitrate of soda, an examination is required of the salts in the rocks of the Corderillas, the drainage from which would find its way into the plain of Tamarugal.

As a manure, nitrate of soda is of course treated as a source of nitrogen. It is not sufficiently realised how valuable the soda

base may be. This is not because soda is in any way necessary to the nutrition of the plant, but because of the action of any soluble salt upon the insoluble potash compounds in the soil. The potash of the soil is due to the partial weathering of double silicates like felspar, into clay, which is not to be regarded as pure kaolinite, Al_2O_3 $2SiO_2$ $2H_2O$, but as containing a certain proportion of zeolitic bodies intermediate between felspar and kaolinite—hydrated double silicates containing potash, soda, magnesia, and lime combined with alumina and silica. Any soluble salt, and particularly a soluble soda salt, will react with these zeolites and exchange bases to an extent depending upon the relative masses of the two bodies, hence nitrate of soda acts on the clay in the soil and brings a little potash into solution. To such an extent does this action take place, that in practice a dressing of nitrate of soda on any but the lightest soils will dispense with the necessity of any specific potash manuring even for potash-loving crops.

This is well illustrated in the Rothamsted experiments (see Table XI.) upon mangels, if we compare the yields on the plots receiving equivalent amounts of nitrogen as nitrate of soda, sulphate of ammonia, and rape cake, both with and without potash. The table refers to the season of 1900, the 25th year of that series of experiments, when it might be supposed the potash in the soils of the plots receiving no potash in the manure must have become thoroughly exhausted :—

TABLE XI.

Plot.		With Nitrate of Soda.	With Sulphate of Ammonia.	With Rape-cake.
		Tons.	Tons.	Tons.
6	Superphosphate and potash	29·6	28·2	29·4
5	Superphosphate only	28·3	12·0	14·9

The plots receiving potash all give about the same yield whatever the source of nitrogen, but on plot 5 without potash the yield is only maintained on the nitrate of soda plot; on the other two the plant is neither supplied with potash by the manure, nor is the soil forced to give up its reserves as it is by the nitrate of soda alone, and the yield declines by one-half or more. In twenty-five years, then, the use of nitrate of soda alone has enabled the soil to supply a mangel crop with the large amount of potash it wanted, though the store of potash in the soil apparently soon becomes exhausted when a manure is used which cannot bring it into solution. With other crops the same results are manifest, though not so quickly as in the case of mangels. For example, we may compare the yield of barley (Table XII.) for successive ten year periods, and to eliminate seasonal influences the yield of each plot will be calculated as a percentage of that on the completely manured plot receiving nitrate of soda.

TABLE XII.

BARLEY GRAIN, HOOSFIELD, ROTHAMSTED.

Plot.		10 years, 1852-1861.	10 years, 1862-1871.	10 years, 1872-1881.	10 years, 1882-1891.	10 years, 1892-1901.
4 N	Nitrate, superphosphate and potash	100	100	100	100	100
2 N	Nitrate and superphosphate...........	98·0	100·2	99·5	105·7	101·4
4 A	Ammonia, superphosphate and potash	92·4	93·7	97·2	100·7	100·8
2 A	Ammonia and superphosphate	91·4	97·8	96·0	90·8	77·8

It will be seen that when the manure contains potash the ammonia salts yield practically the same crops as nitrate of soda. When the nitrogenous manure is nitrate of soda the omission of potash causes no dimnution in the yield; but with ammonia salts and no potash the crop after the third decade becomes unable to satisfy its potash requirements from the soil alone and the yield declines. In other words nitrate of soda has dispensed with the necessity of a potash dressing, which is wanted when sulphate of ammonia is the nitrogenous manure.

One of the most characteristic effects of the use of nitrate of soda as a manure, either repeatedly or in any quantity, is its deleterious effect upon the texture of a heavy soil; farmers have repeatedly observed that the land remains very wet and poaches badly if it is at all disturbed before it has dried. Market gardeners in particular, who manure heavily with nitrate of soda, have found this destruction of the tilth a serious drawback to its use. The cause has usually been put down to the hygroscopic character of nitrate of soda; since the salt itself readily attracts moisture from the air and will even liquify spontaneously, it is considered that it keeps the land moist for the same reason. But the extra amount of mois-

ture that could be held in the soil by a few hundred-weight of nitrate of soda would be wholly imperceptible when distributed through the hundred tons or more which the top inch of soil weighs per acre, even if the application of nitrate of soda persisted near the surface and were not quickly washed down in the soil. Some of the Rothamsted plots in the Barnfield growing mangels, where very large amounts of nitrate of soda have been applied year after year for the last fifty years, show this deterioration of tilth in very marked fashion, the land being intolerably sticky after rain and drying into hard intractable clods, so much so that it is very difficult to secure a plant of roots unless the season is favourable. Determinations, however, of moisture in the surface soil do not show any sensible difference between these plots and those working more kindly, so that we must put aside the idea that there is any direct attraction of water by nitrate of soda remaining in the soil. The explanation appears to be more complex. When a plant is feeding upon a neutral salt like nitrate of soda it takes up rather more of the nitric acid than of the soda, leaving some of the soda in the soil combined with carbonic acid excreted from the root. Water cultures in which plants are grown with nitrate of soda will actually become alkaline to test paper from this cause. Now a very small quantity of a free alkali like carbonate of soda has an altogether disproportionate effect upon clay; the clay is deflocculated, *i.e.*, the little aggregates of very fine particles which cause the clay to crumble down when dry and to allow water to drain through it, are immediately resolved into their finest state of division, and all the characteristic properties of clay are accentuated. Deflocculation is effected mechanically whenever clay is puddled or worked in a wet condition, and all the features of puddled clay, which is both retentive of water and impermeable by it, which shrinks greatly in drying and then holds together with extreme tenacity, are found in these soils when the deflocculation is brought about by a little dissolved alkali. The fact that such deflocculation has taken place may be illustrated by a very simple experiment. Here are two large jars, each containing three litres of distilled water, in which has been shaken up one gram of the Rothamsted clay loam, in the one case from a plot manured with nitrate of soda, in the other, from the adjoining plot receiving ammonia salts. It is already obvious how much longer the nitrate of soda jar is going to be before the sediment has all deposited, which means that the soil under these influences is kept in a more fine-grained and less flocculated condition. Collateral evidence is furnished by some of the other Rothamsted plots; for example, when the tile drains beneath the wheat plots run, the water percolating from below the nitrate of soda plot is always slightly turbid with fine suspended clay material, while the water from the other plots is clear. This removal of the finest material from the nitrated plot has been so persistent during the fifty years or so of experiment on this field, that it is now even perceptible in the analysis; it has only been possible because of the deflocculation brought about by the nitrate of soda manuring.

Again, the soil of these pilots receiving nitrate of soda is found to be losing carbonate of lime to the water percolating through it at a lower rate than the soil of the unmanured plot; this is because the production of a free base by the plant's own growth has, to a certain extent, saved the carbonate of lime in the soil from attack. The following Table (XIII.) shows the annual average rate of loss of carbonate of lime for the last

TABLE XIII.—Calcium Carbonate in Broadbalk Wheat Soils.

1st Depth (1-9 inches).

Plot.		Per cent. in fine dry soil.		Loss per acre per annum.
		1865.	1904.	
		Per cent.	Per cent.	lb.
3	Unmanured	4·54	3·29	800
9	Complete minerals and 275 lb. nitrate of soda	4·24	3·36	564
7	Complete minerals and 400 lb. ammon. salts	3·82	2·25	1010

forty years from some of the chief plots of the Broadbalk field; it will be seen that the nitrate of soda has reduced the loss of carbonate of lime from the soil. The bad texture of the land induced by the use of nitrate of soda is not easily removed; lime is of no service in this case, because it only adds another alkali; a better remedy is to be found in the simultaneous application of an acid manure like superphosphate. Or a mixture of sulphate of ammonia with nitrate of soda might be employed; for, as will be seen later, sulphate of ammonia acts on soil like an acid, hence a mixture of the two manures ought to

make a better source of nitrogen than either alone.

The great rival of nitrate of soda is at present sulphate of ammonia, of which over 200,000 tons are annually produced in this country. The source of origin is coal, which contains about 1·5 to 2 per cent. of nitrogen derived from the original vegetable matter giving rise to the coal. When coal is subjected to any destructive distillation by heat, as in the process of gas-making or even when it is burnt, about fifteen per cent. of its nitrogen is given off as ammonia, which may be recovered from the gases by simply washing them with water. The ammoniacal gas liquor thus produced is redistilled into sulphuric acid and the sulphate of ammonia crystallised out; the commercial salt resulting contains about 20·5 per cent. of nitrogen. Not only gas works, but blast furnaces, coke ovens, shale oil works, &c., are now arranged to recover this valuable product of the coal, and the accompanying Table (XIV.) shows the current output from each of these sources.

TABLE XIV.—PRODUCTION OF SULPHATE OF AMMONIA IN THE UNITED KINGDOM.

Source.	1901.	1900.	1899.
	Tons.	Tons.	Tons.
Gas works	148,500	142,000	134,000
Iron works	16,000	17,000	18,000
Shale works	36,500	37,000	38,500
Coke, &c., works	19,000	17,000	15,000
Total production	220,000	213,000	205,500
Exports	150,203	145,285	140,371
Home consumption	69,797	67,715	65,129
Average price ..	£10 11 4	£11 2 0	£11 5 10

As a nitrogenous manure, sulphate of ammonia is practically as effective, nitrogen for nitrogen, as nitrate of soda; it is also to all intents and purposes as rapid in its action, for the process of nitrification, which generally precedes the utilisation of the ammonia by the plant, takes place very rapidly in suitable soils. The fact is well illustrated in the following Table (XV.), showing the composition of the water draining from one of the Rothamsted wheat plots to which a mixture of sulphate and chloride of ammonia had been applied on October 25th, followed the next day by heavy rain, so that on the 27th the drains began to run. It will be seen that at this early date the ammonia had not been wholly caught up by the soil, so that a little found its way into the drains; at the same time, however, the proportion of nitrate has been enormously increased, due to immediate nitrification, and the later runnings of the drains in November and December show that the ammonia salts were being rapidly oxidised and removed from the soil as nitrates.

TABLE XV.—BROADBALK WHEAT FIELD, ROTHAMSTED.

Nitrogen and Chlorine in Drainage Water from Plot 15. Parts per million.

	Nitrogen as Ammonia.	Nitrogen as Nitrates.	Chlorine.	Nitrogen as Nitrates to 100 Chlorine.
1880. Oct. 10	None	8·2	22·7	37·0
1880. Oct. 27, 6.30 a.m.	9·0	13·5	146·4	9·2
1880. Oct. 27, 1 p.m...	6·5	12·9	116·6	11·1
1880. Oct. 28	2·5	16·7	95·3	17·5
1880. Oct. 29	1·5	16·9	80·8	20·9
1880. Nov. 15, 16	None	50·8	54·2	93·7
1880. Nov. 19, 26	None	34·6	47·6	72·7
1880. Dec. 22, 29, 30..	None	21·7	23·2	93·5
1881. Feb. 2, 8, 10....	None	22·9	19·4	118·0

But though the yield produced by nitric and ammoniacal nitrogen is much the same, with a little advantge on the side of the nitrate, there are certain specific differences in the action of the two manures which are worthy of examination. It has been already explained that the soda base in the one case is of some service in liberating the stock of potash in the soil; the fact that in sulphate of ammonia the nitrogen is combined with an acid, and contains no fixed base causes the manure to be positively harmful on certain soils. When sulphate of ammonia is applied to the soil the first action is an interchange between the ammonia and some of the bases in the soil, the ammonia takes the place of an equivalent amount of lime and magnesia in the zeolitic double hydrated silicates in the clay, but finally the reaction mainly falls upon the calcium carbonate in the soil, ammonium carbonate being formed as a preliminary to nitrification and calcium going into solution as calcium sulphate. Referring again to the analyses of the Rothamsted wheat soils, it will be seen that the long continued use of ammonia salts has reduced the proportion of calcium carbonate below that of the unmanured plots by amounts which are approximately those to be expected if a reaction of the nature—

$$(NH_4)_2 SO_4 + CaCO_3 = (NH_4)_2 CO_3 + CaSO_4$$

alone took place.

The Rothamsted wheat soils started with sufficient calcium carbonate to withstand this loss, but on soils initially poor in calcium carbonate its removal by sulphate of ammonia soon induces a condition approaching actual sterility. The best example is afforded by the experimental plots on the farm of the Royal Agricultural Society at Woburn, where the soil is sandy and only contained at the outset 0·087 per cent. of calcium carbonate. There, through the continued use of ammonia salts as manure, the soil refuses to grow barley any longer, though the former fertility is at once restored by the application of a dressing of lime. At Woburn, the soil of these plots receiving ammonia salts is actually acid to litmus paper, and a similar condition prevails on some of the grass plots at Rothamsted, where the soil, unlike that of the wheatfield, is deficient in calcium carbonate. The origin of this acid reaction is not exactly easy to understand, for there is never any production of acid by the mere reaction of sulphate or chloride of ammonia with any of the constituents of soil—clay, humus, or silica. As far as the investigation has yet proceeded the acid reaction is due to the attack of soil organisms, chiefly fungi, upon the ammonium salts, the ammonia being withdrawn to leave the acid free. Although, under ordinary farming conditions, an actually acid reaction is not likely to arise through the use of sulphate of ammonia, the experiments at Woburn and Rothamsted clearly indicate that it is not a desirable source of nitrogen for soils which are deficient in calcium carbonate. The reaction of ammonium salts with the soil, resulting in the withdrawing of the ammonia from solution, gives a clue to the difference in both the yield and the character of the crop when grown with sulphate of ammonia and nitrate of soda respectively. On the grass plots at Rothamsted, for example, where the manuring has now been repeated year after year for fifty years, very distinct types of herbage have associated themselves with the two manures. Putting aside the prevalence of sorrel as due to the acid conditions also brought about by the ammonia salts, the characteristic grasses are of shallow-rooted habits, *e.g.*, sheep's fescue and sweet vernal grass, while the nitrate of soda has favoured deeply-rooting grasses like the soft brome. Actual examination of the subsoil shows that the roots have penetrated much deeper on the nitrate of soda than on the ammonia plots; the roots having followed the soluble nitrate down into the soil in the one case, whereas in the other they remain near the surface where the nitrogenous material has been accumulated. We may apply the clue thus obtained to interpret the comparative results given by the two manures on other crops; wheat, for example, a deep-rooted crop, may be compared with barley, which feeds near the surface, and again with mangels, another deep-rooted crop.

TABLE XVI.—AVERAGE ROTHAMSTED CROPS.

	Average Yield.		
	Wheat. (22 years.)	Barley. (51 years.)	Mangels. (27 years.)
	Bushels.	Bushels.	Tons.
Complete manure—			
Nitrogen as nitrate ..	28·7	43·5	18·01
,, ,, ammonia .	23·4	42·1	14·86

It will be seen that with the deep-rooting crops, wheat and mangels, nitrogen in nitrate of soda gives a better return than an equivalent amount of nitrogen in ammonia salts, although other disturbing factors, such as lack of potash or lime, do not intervene; with barley, however, the yield is sensibly equal with the two manures. At the time of harvest, the crop grown with ammonia salts is always a little the riper; in the case of barley, this is of distinct value, for it results in a more uniform product of higher quality. With the mangels particularly it is seen that the plants manured with nitrate continue to grow long after those manured with ammonia salts have so completed their season's growth that the leaves are beginning to turn yellow and flaccid. All these differences are explained by the deeper rooting habit induced by the nitrate, the plant is less affected by the drought and the changes of temperature incident to autumn, growth is more prolonged, with the corollary of a larger yield but a later and less uniform maturity.

One other factor may also contribute to the general superiority of nitrate of soda. It must not be forgotten that when a nitrogenous manure reaches the soil there will be competition for it between the plant's roots and the mass of living organisms present in the soil, nearly all of which required combined nitrogen for their own development. Some of these organisms, like the nitrification bacteria, are wholly useful. Others cause permanent loss by liberating some of

the nitrogen in the form of gas, but the majority simply withdraw the soluble nitrogen for a time from circulation, building it up in their own tissues. The immediate result is, however, a lessened availability of the manure, and this loss will fall far more upon ammonia compounds than upon nitrates, which are not so generally utilisable by the organisms found in the soil.

It is generally assumed that since nitrate of soda is not retained by the soil, whereas ammonia salts are, the former is a manure better suited to dry seasons and climates, whereas under wetter conditions there is less danger of the latter washing out of the soil. This view, however, forgets that if the ammonia salts are to feed the plant they must be nitrified, and that the calcium nitrate produced is just as likely to be washed down in a wet season. Indeed, the Rothamsted results do not bear out the popular idea. In exceptionally dry seasons there may be some advantage from the use of nitrate of soda because of the deep-rooted habit it induces, but the advantage is still more pronounced in seasons of excessive wet. Taking an average of the wet seasons against the dry, the ammonia salts do better in the latter. Probably the nitrification of the ammonia salts is checked in wet seasons when the temperature is low, and when also aëration is deficient through the repeated saturation of the soil.

It has been assumed that nitrification is a necessary preliminary to the utilisation of ammonia salts by the higher plants, but this point of view is probably too sweeping. Mazé and other investigators have shown for laboratory cultures that plants may feed directly upon the ammonium radicle; and on the Rothamsted grass plots we have evidence that such an action is taking place on a large scale. It has already been mentioned that the soil of the plots constantly receiving ammonium salts has developed an acid reaction, on which, however, a luxuriant vegetation is still maintained. Yet the action of the nitrifying bacteria is suspended by a very small degree of acidity in the medium, and examination of these soils shows them to be almost devoid of nitrates down to the depth of three feet, and even incapable to giving rise to nitrification when seeded into a suitable medium. It is certain that in the soil of these plots nitrification, if not entirely suspended, is reduced to such small proportions that it cannot account for the nitrogen taken up by the crop.

The problems presented by nitrate of soda and sulphate of ammonia are so many and interesting that but little time is left for the discussion of the many important fertilisers in which the nitrogen is present as some organic compound. Of these fertilisers, Peruvian guano is perhaps the oldest and most widely known; news of the deposits was brought to Europe by Alexander von Humboldt in 1804, but it was in 1839 that a small consignment of two tons first reached Liverpool, to be followed the year after by a cargo. The demand increased so rapidly that by 1845 the shipments for the year had reached nearly 300,000 tons. The origin of the guano deposits will be considered in a later lecture; it is sufficient in this place to say that the proportion of nitrogen a guano contains depends upon the character, mainly upon the age, of the deposit from which it is worked. In the various grades in comm;e the nitrogen will vary from as much as 18er cent. in the finest Chinchas guano, dov to 2½ per cent. in the so-called phosphatic gnos, the grade usually met with containing or 7 per cent. The great virtue of Peruvianuano, which distinguishes it from most of thother fertilisers, is the varied state of combinion in which the nitrogen is found; the origkl deposit probably contained little beyond uc acid and proteid nitrogen, but by the pross of decay, which has already set in, a nuner of compounds have been formed, including; the following analysis (Table XVII.) shows, nitr. e.

TABLE XVII.—ANALYSIS OF CHINCHAS GUANO, 1897.

	Per cent.
Nitrogen as uric acid	8·85
Organic nitrogen	2·98
Nitrogen as ammonia	3·94
Nitrogen as nitric acid	0·32
Total	16·09
Phosphoric acid—soluble	2·63
,, soluble in citrate	6·29
,, insoluble in citrate	0·37
Total	9·29

salts of ammonia, urea, uric acid, and other more insoluble compounds of an organic nature. Thus while some of the nitrogen is immediately available, other compounds are less active and must undergo some bacterial change in the soil before they are ready for the plant. The plant is in consequence fed steadily and continuously without being presented with an

excess of nitrogen at the earlier stages of its growth; furthermore, whatever changes of temperature and water supply take place to stimulate or check the growth of the plant, they will have a precisely parallel effect upon the bacterial changes which break down the compounds of the guano into plant food. It is found by experience that a plant supplied in this way with nitrogenous food, as it needs it, is generally healthier, and gives rise to produce of higher quality than one which has had an overplus of food in its earlier stages.

Besides the true guanos, of which smaller supplies reach this country from some of the islands off the South African coast, there are a number of other products, the *débris* of certain food-preparing processes, sometimes called guanos, which agriculturally behave in a very similar fashion. For example, in the making of cod-liver oil and in various fish-curing processes, large residues of fish offal are obtained, which are desiccated, ground to a powder, and sold as fish guano. The percentage of nitrogen will vary from nine down to five, of phosphoric acid from five to ten. Similar products, known as meat guanos or meat meals, are prepared by manufacturers of meat extracts, tinned meats, &c., the whole of the animal not otherwise utilisable being dried and ground down. The composition of these meat products again will vary from as highly nitrogenous a material as pure dried blood with 12 per cent. of nitrogen to mere bone meal with not more than 3 per cent. Another class of organic nitrogèn fertilisers are of vegetable origin, the residue of seeds from which the oil has been extracted, and which for some reason or other are unfit for consumption by cattle. Of this class of bodies the best known here in England is rape dust, the meal from extracted rape seed, containing about 5 per cent. nitrogen with about half as much phosphoric acid. In India and other tropical countries castor cake, the residue from which castor oil has been expressed, forms a good and cheap source of organic nitrogen. Another important class of nitrogenous fertilisers embraces all the industrial waste of manufacturing processes dealing with wool, silk, fur, and other materials of animal origin, but not, however, cotton, linen, or hemp residues, for they contain no nitrogen. In general these waste products are termed shoddy, and their composition is purely a matter of origin. Pure wool contains 18 per cent. of nitrogen; shoddies having a woollen basis may contain as much as ten or as little as three per cent. of nitrogen.

These organic nitrogenous fertilisers have each their own peculiarities, though they have never been studied in detail like sulphate of ammonia or nitrate of soda, but they have certain properties in common. In the first place, they are more slowly acting and less available to the plant than the two manures just specified, the rapidity of their action depending both on their composition and their mechanical condition, especially the fineness of their division. Peruvian guano and dried blood would come at one end of the scale, material like ground hoofs and horns or leather at the other. The more slow acting a nitrogenous manure is the greater is the proportion that will be practically wasted, inasmuch as it will escape recovery not only in the crop to which it was applied, but in all succeeding ones. At Rothamsted, where farmyard manure is applied year after year, not more than 26 per cent, of that applied to the wheat during the last fifty years has been recovered in the crop; where the crop has been mangels, the proportion recovered has reached 31 per cent. There is, of course, a great residue left in the soil of each of these plots; indeed, other experiments at Rothamsted show that after forty years some of the nitrogen applied as farmyard manure is still coming out in the crop. However, when the farmer has to wait as long as forty years he practically does not recover it at all, hence slow acting manures are inevitably wasteful. Various tables have been drawn up showing the relative activity of the various nitrogenous manures, but these we owe to continental observers and they are entirely based upon experiments in pots. For this purpose pot experiments are quite untrustworthy; the few existing field experiments tend to show that the activity and therefore the manurial value of these organic nitrogen compounds, even of such a material as shoddy, have been largely under-rated. The Rothamsted experiments upon barley and mangels would show that rape dust is almost as active a source of nitrogen as sulphate of ammonia, the crop recovering quite as high a proportion of the nitrogen applied; other experiments confirm this view based on long-continued trials by showing the effectiveness of rape dust in a single year's trial. Discounting, however, the prevailing false impression, there still remains the fact that these manures are, on the whole, more slow acting and less perfectly recovered in the crop than are nitrate of soda or sul-

phate of ammonia. Nitrogen for nitrogen they should be therefore less valuable, hence it is surprising to find that, putting aside the shoddies, the unit of nitrogen always costs more in organic than in inorganic combination. What, then, is the origin of this strong prejudice of the farmer in favour of an organic source of nitrogen, a prejudice which is further seen in the common description of nitrate of soda and sulphate of ammonia as stimulants or even "scourges" of the soil rather than plant foods. Of course no purely nitrogenous substance is a complete manure, and cropping with one alone must eventually exhaust the land in phosphoric acid or potash, but as has already been shown, the reserves of such materials in the soil are so large, that long-continued cropping would be needed to deplete them seriously.

Some other source must be found for the farmer's prejudice, and its true cause is probably the manner in which organic manures improve the tilth of the soil, whereas sulphate of ammonia and particularly nitrate of soda injure it. The importance of this factor of tilth will be more realised when we remember that nearly the whole of the farmer's labour in spring is directed towards attaining a fine seed-bed for such crops as barley and roots. Furthermore, if the weather conditions are adverse to the start of the crop, the eventual yield will depend more upon the condition of the seed-bed than upon any other factor.

The potent effect of organic manures in promoting a good tilth is very clearly shown by the Rothamsted experiments upon mangels, where the nitrogenous manures are nitrate of soda, sulphate of ammonia, and rape cake respectively. In a good season the nitrate of soda is perhaps the most effective manure, but taking an average over the whole period, rape cake shows a great superiority, simply because of the difficulty of getting a full plant upon the other plots. Though all are cultivated in the same way and at the same time, the condition of the soil has become so bad where purely inorganic manures have been used, that only in favourable seasons is what a farmer would call a good plant obtained on the nitrate and the ammonia plots, whereas the rape cake plot crops regularly enough. On three occasions the plant has completely failed on the ammonia and nitrate plots. Even in the other years there are great deficiencies, as shown by the average number of plants counted on each plot.

TABLE XVIII.—ROTHAMSTED MANGELS, 1876-1902.

Plot.	Manures.	Average Crop per Acre.	Average Number of Roots per Plot.
		Tons.	No.
	Complete minerals		
4 C ..	with Rape cake	21·3	17·474
4 A ..	„ Ammonia-salts ..	14·9	14·802
4 N ..	„ Nitrate of soda ..	18·0	14·130

In ordinary farming, the effect upon the soil is never likely to become so pronounced as in these experiments at Rothamsted, but without doubt a considerable element in the extra value which the farmer sets on organic nitrogen must be put down to its improvement of the texture of the soil, a factor the farmer rightly regards as of the first importance.

APPLIED ART SECTION.

Tuesday evening December 18; LEWIS FOREMAN DAY, F.S.A., Vice-President of the Society, in the chair.

The CHAIRMAN, in opening the proceedings, said that the present was the first meeting for the session of the Applied Art Section. It was not always easy to find men who if they knew all about their trade were willing to impart their knowledge to an audience. Mr. Okey was not only a practical basket-maker who knew all about basket-making, but was willing—as he was able—to tell his hearers all he knew.

The paper read was—

BASKET-MAKING.

By THOMAS OKEY.

It once chanced that being among a group of young university men at the Whitechapel Settlement, the talk fell upon what craft would be most useful supposing a man were cast upon his own resources on land virgin of human contact. Many were suggested, but it seemed to me that my own craft, that of basket-making, would not be found the least advantageous. For the basket-maker, in primitive communities, has a wide range of activity. He is the house builder, the military engineer, the boat builder, the maker of innumerable domestic utensils, including vessels to hold and heat water. Even in these days of complicated industrial development he

is with us from the cradle to the grave, he makes the first receptacle wherein we are rocked to sleep in our infancy and, in some cases, the house wherein we are laid to sleep, the last sleep of all, in the silent realms of death. The craft is not only important in itself, it has been the cause of greatness in other crafts. It was the parent of all the textile arts; for basket work is literally a weaving process. The willow pattern in old china, the basket capitals and braided mouldings in Byzantine architecture are derived from basket work, and the curious patterns found on some old ceramic ware have been traced to the marks left on the clay by the basket mould which was in use before the invention of the potter's wheel; and to this day wicker shapes are used by the Japanese for their vessels of lacquer ware. The earlier settlers in Rome and in Western Europe generally constructed their houses of osier work plastered with clay, and they raised their defensive walls of the same material. From a letter of Cassiodorus we learn that, in the early sixth century, the Venetians opposed a dyke of twisted and knotted osiers to the devouring fury of the waves.

Some interesting remains of osier dwellings were discovered, in 1877, at Mount Caburn, near Lewes, in Sussex, by Major-Gen. Pitt-Rivers, and are described in Vol. 46 of "Archæologia." The Roman invaders of Britain found boats of osier, covered with the skins of animals, in use, which seem to have been of the ordinary boat shape, although those mentioned by Herodotus, as used on the rivers Tigris and Euphrates, were round, and covered with bitumen.

By the courtesy of Mr. W. P. Ellmore, of Leicester, I am enabled to exhibit a specimen of a boat obtained at a great cost of carriage from the Euphrates valley and exactly similar to those described by Herodotus. The winnowing fan here shown, probably the last made or ever likely to be made in England, is also the property of Mr. Ellmore, and was made some years ago by an old Midland workman.

The word fan in this sense is derived from the French *van*, an osier vessel of wicker, used from time immemorial for winnowing corn in Latin countries and known to the Romans as a *vannus*. The French words for a basket-maker *vannier* and for basket work *vannerie* are still in common use to-day all over France. Littré traces this old word to the Sanskrit *va*, meaning to breathe or to blow.

A very curious survival of the primitive use of wicker work comes annually under my notice in the east of London. At the anniversary of each celebration of the Feast of Tabernacles I am always asked to make at my workshop in Whitechapel a number of basket *succas* or booths under which the poorer Jews sit to carry out their quaint symbolic ceremonies in the back yards of the Whitechapel ghetto.

Before further progress in my subject, let me refer briefly to the material which from time immemorial has been chiefly employed in the art of basket work all over Western Europe, and in temperate climes generally. And I do so on this occasion with the more interest and propriety since your admirable Society, which has done me the honour to ask me to address you to-night, is historically associated with the development of osier culture in this country. From the years 1793 to 1805 I find in your records many references to money prizes and gold and silver medals awarded to successful planters of osiers. The rewards were offered at the instance of the basket-makers of London, and I have no doubt were prompted by the failure of supplies from France and the Low Countries during the French wars, and the disastrous effects of the Napoleonic continental system.

The prizes were offered to the person who between October 1st and May 1st shall have planted the greatest quantity of land, not less than five acres, with those kinds of willows commonly known by the names of Osier, Spaniard, New Kind, and French, fit for the service of basket-makers. Much curious information may be gleaned by perusing your records during the years I have mentioned, as to the methods of culture, terminology, and values of osiers in those days.

The most amazing delusions have and do now prevail as to the origin and provenance of the material used by the basket-maker. I have before me as I write an enquiry from a lady wishing to teach the village lads basket-making, "but who didn't know how to cut the willows from the trees," which were abundant in her neighbourhood. Need I say that osiers are not cut from trees, but from cultivated beds?

It is very generally supposed too, that any poor marshy land is good enough to plant with osiers, and that once planted, little attention is needed. Nothing could be further from the facts. No crop responds more readily to careful husbandry and intelligent cultivation. For the successful raising of the finer sorts, such as are now in demand, good well-

drained upland loamy soil is required, which, before planting, must be well trenched and cleaned; when the "sets" are planted, frequent weeding is imperative, and the ground, if not subject to periodical alluvial floods, should be manured every year.

Mr. John Shirreff, of Haddington, N.B., winner of your gold medal in 1802, had planted clayey loam, which had formerly been under the usual rotation of crops, and several times laid down under pasture. The land had been well ploughed, and manured for planting. Listen to the careful cultivation he practised: in May, the whole bed was hoed over; in June it was again gone over with the Dutch hoe, and left as fair and clean as any garden; in August it was hand-weeded, and some patches were hoed a third time. The result was an excellent crop, which realised £18 10s. an acre. Mr. W. P. Ellmore, of Leicester, has been wont to weed his grounds five or six times in certain years.

If the requisite capital is available, and the conditions which govern productive cultivation are observed, osier growing is a profitable occupation. At Rome, in Cato the elder's time, an osier bed was held to be only less profitable than a vineyard or a market garden, and coming to modern times I am acquainted with one farmer at least in the West of England who was saved from disaster in the bad years of the latter half of last century by the profits on his crops of osiers. It is much to be regretted that so large a proportion of the material used in this country is imported from abroad and not produced at home. In the Board of Trade returns for last year the import values of willows for basket-making amounted to £62,286, an increase of £10,000 since 1900, when the values were first specified.

The farming of osiers is no less healthy and pleasant than profitable. Who that has been present on the grounds when stripping is in progress can forget the sweet fragrance of the whitened rods. "I love sweet odours," writes Aspasia to Cleone in Landor's "Pericles and Aspasia." "Pray Cleone! have you no willows fresh peeled? none lying on the bank for baskets, white, rounded and delicate as your fingers? How fragrant they were formerly! Ah! I shall always love the smell of the peeled willow." But I must not be tempted to dwell on osier growing, and will now briefly refer to one other and not an indigenous material increasingly used by the basket-maker in this country. The mention of cane will perchance evoke bitter memories of pedagogic discipline and the weals and woes of schoolboy days; to the basket-maker it furnishes one of the most valuable of his materials. Until recent times it was employed either whole or split into skeins which will be familiar to all from their use in cane-bottom chairs. About 1880 the central pith of the cane, prepared in long rods of varying sizes, was introduced into England under the terms Cane Pith or Cane Pulp. Its somewhat stringy nature and facility of manipulation have led to its being used for cane-weaving by children and women as well as by the professed basket-maker.

Excellent work of this kind has been produced by some of the women workers, but the economic results are of small value, and the terminology in use is uncouth, confusing, and amateurish. In one handbook, the term "spoke," itself unknown to the professional, is made to do duty for no less than five separate and different strokes. By the trade, prepared cane pith is employed wholly or partly in the making of chairs, tables, luncheon, tea, and other baskets.

A delusion no less amazing exists as to the status of the basket-maker. When I was first appointed examiner to the City and Guilds of London Institute, I found basket work classed with millinery and dressmaking, and in the new edition of the most popular and well-informed books of reference, "Chambers' Encyclopædia," we are informed that "a large number of poor persons are engaged in the manufacture of baskets which are hawked about the streets by their wives and children." It is as one of these poor persons who has earned his living as a journeyman basket-maker for 17 years and a master for 20 that I address you this evening. The fact is that to become an expert basket-maker a considerable native aptitude and long training are required. The basket-maker is in every sense a craftsman; no machinery is used, and the ultimate perfection of shape and beauty of texture depend upon the more or less perfect conception of beautiful form in the mind of the artist, and the power of the fingers to impress such form on a recalcitrant material. Every stroke has a permanent effect on the symmetry of the whole; no subsequent pressure will alter it; it is impossible to mould into good form work that has been ill-shapen in any part of the weaving. The results are as irrevocable as those of actions good or bad in the moral world.

The wages of an expert workman are consequently fairly high, and £2 10s. per week, or even £3 per week I am told, though this has

not come within my own experience, are earned: at coarse work the wages average from 25s. to 35s. per week. A good workman is never out of work; no loss of pay is ever incurred through frost or other climatic disabilities, as in the building trades. The workman is efficient, even in old age; for by an unwritten law, the older men in the shop are given the privilege of the lighter work. An excellent old "square" hand, who worked for three generations of my family, died this year considerably over seventy years of age, and with a little financial help, and his club pay to tide him over temporary ill-health, was able to hold his plank until within a very few weeks of his end. He was the last man I knew who had made, and could still make, the various kinds of the old English reticule.

The Basket-makers' Trade Union, founded in 1816, is one of the oldest and most flourishing of the London unions. Since 1850, the oldest list I have, a very considerable rise in wages has taken place, both in piece and time work; in the latter from 6d. to 9d. per hour, and the employer now finds artificial light instead of the workman. A very great advance has taken place in my time in the social habits and intelligence of the workman. The old hard-drinking, hard-swearing twiggy, groping at his work in a cellar by the dim and uncertain light of a rush-light fixed in a cleft stick and stuck into the wall, has long disappeared; and on entering as president of the Osiers Cricket Club, mainly composed of the younger generation of workmen, to take my place at the annual dinner last year, I at first sight almost doubted whether I should find myself the only person not in broad cloth.

A glance through our old lists is not without its interest to the student of social changes. In all those I posses from 1850 to 1877 the wicker instruments specified as "bug traps" are listed. In 1896 they disappear—an interesting evidence of the increased cleanliness of the community and of the supersession of the old wooden bed by the iron one. The old measurement by nails (2¼ in.) instead of inches has entirely gone. The old yard stick was literally marked with nails. The basket-maker is one of the few remaining workmen who sings and talks at his work, and a basket-maker's shop—at least in the earlier days of the week—holds a somewhat boisterous company. I am bound to say that the wit is often somewhat Rabelaisian, and a modification of Terence's line, "Nihil *feminæ* a me alienum puto," occupies a too large part of the conversation. When working alone, he has opportunity for pensive meditation. One of our fellows, Thomas Miller, the basket-maker poet, was able to beat his music out as he sat on his plank in a little shop in Elliot's-row, Southwark, labouring, as he said, to consort with the muses and maintain a family. He won a modest footing on Parnassus and his well-known poem "The Fountain" (1839), has found a place in the literary annals of England. He was the author of about 45 works in poetry and prose, and won the esteem of Lady Blessington by a present of some productions of his mind and of his fingers, in the form of a fancy basket, containing a selection of his verses. It was at Lady Blessington's house that he met Disraeli who, in later years, obtained for the old poet a pension of £100 a year from the Royal Bounty Fund.

Some surprise may have been evoked by my use of the term artist in connection with a craft so lowly as that of the basket-maker; this is, however, only because the old word has been so distorted in meaning. In days when people cared for beauty, the use of the term *art* or *artistic* to denote anything outside the ordinary products of human activity, was unknown. Dante, when he wishes to emphasise the degeneracy of the citizens of Florence in his days, says that in olden times their blood ran pure even in the veins of the *ultima artista*—the commonest workman. It is because we have lost the thing that we make a fetish of the word. Indeed of all the shoddy rubbish now sold that described as art basket-work is generally of the shoddiest.

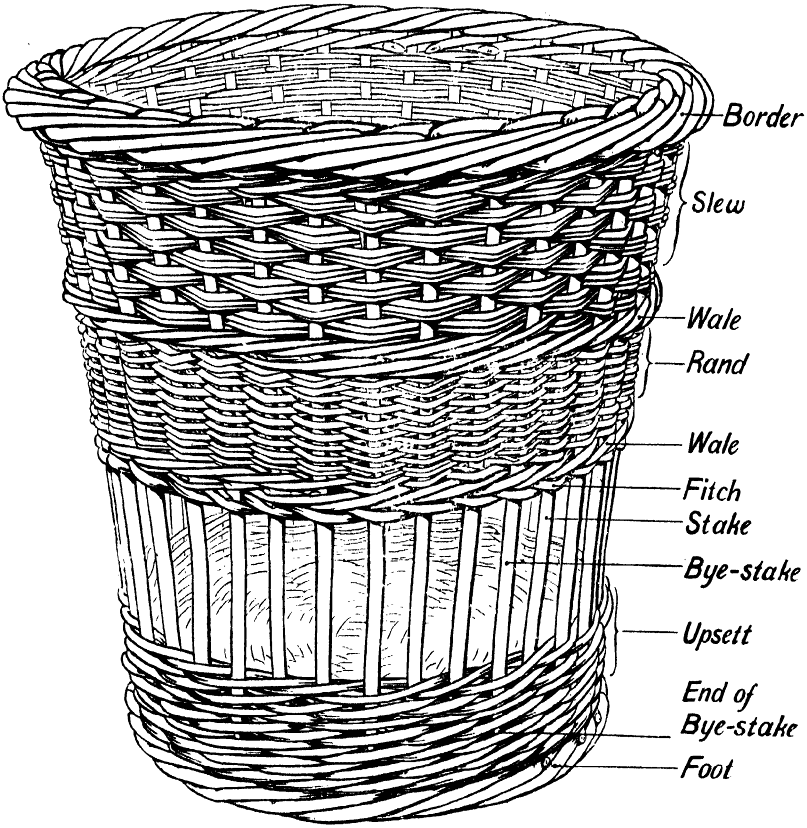
The willows when they reach the workman are known to him as rods, which he roughly classifies as osier and fine. The former is generally used brown for coarse hamper work, and is unstripped; the latter, stripped of its skin, and used whitened or buffed, is employed in the manufacture of the finer classes of work,—buff rods being rods which have been boiled before stripping, and so stained a rich light brown hue, as you see here. The technical terms for the sizes into which the rods are sorted are most ancient and curious. The smaller sizes of brown are known as luke, and the rising sizes as long small, small, threepenny middeboro, and the largest as great. The white is more carefully subdivided, and the smaller sizes are known as tack, short small, long small, &c. Ragged is the rough twiggy stuff which is rejected as valueless for whitening purposes. Having been soaked in tanks the

requisite number of hours or days, the stuff is ready for use. The tools required are few and inexpensive; a shop knife for cutting out; a picking knife for trimming off the rough projecting ends; one or two bodkins for staking up or making handles; an iron for driving the work closely together; a pair of shears for cutting off bottom or cover sticks, and a dog or commander for straightening the sticks that form the rigid framework of square baskets. For finer work the rod is split into three or more skeins by a cleaver; the splits are then successively drawn through a shave to remove the central pith and through an upright to render them uniform in width. This is the full kit. I exhibit here a specimen of each. An ordinary round or oval basket can be made with no other implement than a knife. This paper basket, which I made for the purpose of illustration, I completed with the aid of no other tool than a pocket knife (Fig. 1). The employer provides a lap-board on which the basket is placed while the sides are being filled up, and a block or vice used for gripping the sticks on which the bottoms and covers of square work are woven.

A rod to the workmen has four different parts — the butt, the top, the belly, the back. To make a round basket the workman first cuts off the bottom sticks from the butt end, slipes them and places them cross-wise beneath his feet, and in this position proceeds to weave the bottom. He first binds them together by two rods called slath rods, and gradually opening out the radiating sticks he fills the bottom up to its required width. The first task of an apprentice in my days was confined to making these bottoms—a peculiarly diabolical form of torture known as taking the boy's backbone out. There is a method of making a round or oval bottom in a sitting position by splitting one layer of the cross sticks with a bodkin and inserting the others. This, however, is rarely practised in this country and it is scorned by the English workmen as fit only for women and foreigners. The bottom sticks being cut off (and if the basket is to be a common slewed one) the workman sharpens by two cuts on the back an odd number of stakes which are to form the warp, so to speak, of the sides: these are inserted in the bottom and then pricked up by the point of the knife, gathered into a hoop, and set up or upsetted in the direction of the body of the basket. This being done it is sided up to the requisite depth, the stakes are bordered down, and the projecting tops are cut off. This is known as the belly. If a foot is needed it is now put on by inserting the tops cut off from the stakes alongside the upsetted stakes; the foot rods are waled and then laid down as in a border. A cover is made in similar fashion to the bottom, and handles are fixed by twisting a rod and roping it under and over the border. Note that the plural of foot is not feet but foots. The strokes chiefly used are termed: a slew when two or more rods are woven in together; a rand when one single rod is woven at a time; a pair when two are woven alternately one over the other; a fitch when two are woven alternately one under the other; this last stroke is used for making skeleton work. A wale is three or more rods woven one after and over the other to form a binding or string course. Besides common borders, many other forms, such as plaited, roped, tracked borders, are used.

You will look in vain in any dictionary, even in the New English Dictionary, for reference to these queer technical terms. The etymology even of the word basket is unknown. Much learned stuff has been written in encyclopædias and other works of reference about its derivation from the Latin *bascauda*, and imposing Latin quotations from Martial and Juvenal are cited to prove the connection; but in truth there is no relation whatever between the words, and both Dr. Murray and Professor Skeat are constrained to admit that the origin of the word basket is as yet unknown.

Methods have little changed since primitive times. The oldest wickerwork in existence are two Egyptian workmen's baskets and a fitched papyrus basket, about 4,500 years old, found in an unfinished grave of the fifth dynasty at Deshasheh, and figured in Professor Petrie's report published by the Egyptian Exploration Fund. Mr. T. R. Way has kindly sent down an old Egyptian basket found in a tomb, and on examining it this evening I was interested to find the same strokes—the fitch, the pair, the border, slath, and wale—I had been using yesterday in the making of this paper - basket. Some fitched basket chairs and a basket chariot, preserved in the Etruscan Museum at Florence, are nearly 3,000 years old, and some fitched work by the natives of Tasmania, made before their extermination by the whites, and preserved at Oxford, takes us back to a primitive people only in the neolithic stage of human development. The strokes in these specimens are



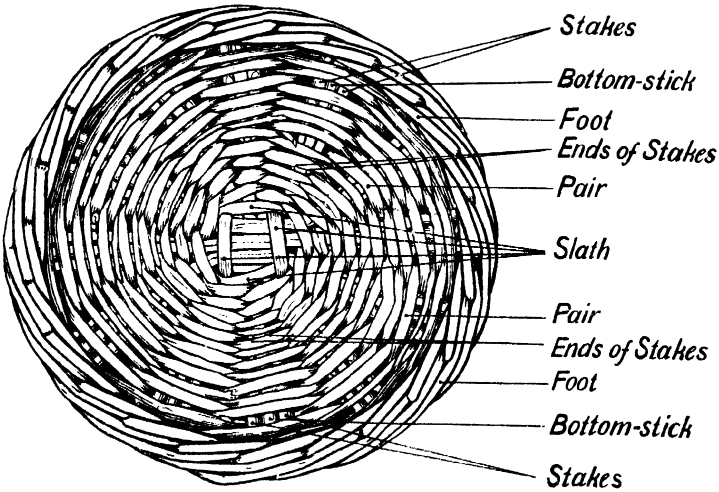


FIG. 1.—CHIEF STROKES IN BASKET WORK.

Engraving ot a waste-paper basket made by Mr. Okey to illustrate the chief strokes used in basket making. It will be seen that the bye-stakes are merely inserted in the upsett, whereas the stakes are driven in at each side of the bottom sticks and pricked up to form the sides. Bye-stakes are only used in fitched work.

the same as those used by the European workman to-day.

In the history of the arts, however, the importance of basket-making is in inverse ratio to the industrial development of a people, and it is among primitive races that the most beautiful work is found.

The Pomo Indian of California* was cradled in a basket, his home was a great thatched basket, his toys were baskets, he ate from a flat basket, and drank from a round one. His meal was winnowed and ground in a basket; his fish and meat were cooked in a basket; his water bucket was a basket; his fish was caught in a basket; when he travelled, his belongings were packed in a basket. If he gardened, his fences were of wickerwork; he trapped birds and game in baskets, and on Lake Clear the art of basket-making was used in making canoes. Until the advent of the white man 50 years ago these strangely remote folk literally had no other vessels, and the number and excellence of her baskets were indicative of the Indian woman's status in the tribe. The time and patience expended are incredible, as much as two years being sometimes required to make one piece of work. Recently a new fad has arisen in America for making collections of these beautiful utensils which have been treasured as heirlooms in Indian families, and large prices have been paid for baskets made by the few squaws who have inherited the traditions and practice of the art. As much as £300 has been paid for one specimen, and it is computed that baskets to the value of £1,000,000 have been drawn from Arizona and California within two years.

Here is a finely woven basket from a poor Italian village near Spongano, in the extreme south. It is made from a local species of flinty sedge, and is sold for 60 centimes (6d.)

Among Eastern natives, the Japanese attained a marvellous degree of excellence in the manipulation of basket-work. The material used, as in the East generally, is bamboo or cane split into skeins. By the courtesy of the South Kensington Museum authorities, I am enabled to show some exquisite Japanese bamboo and rattan ware, and some beautiful work from India and Siam. Nothing can exceed the refinement and art displayed in these admirable specimens. Some excellent modern Japanese work is also shown by the courtesy of Messrs. Liberty and Co.

But the art has not been confined to these peaceful utensils of domestic interest. Of old and among modern savages the shields of warriors and braves have been and are fashioned of wickerwork, either plain or covered with hides; and Xenophon, in his story of the Thirty Tyrants at Athens, relates that the exiled Athenians at the Piræus made to themselves shields of whitened osiers.

A curious development in the use of wickerwork for military purposes took place in this country last year, when the authorities began to use wicker shields of cane pith for the protection of live shells in transit.

During past years the incidence of the work produced in Great Britain has been greatly modified owing to the fiscal changes introduced in the middle of last century. The old English reticule and other small domestic ware have been driven out of the market by cheap and more flashy goods from the Continent. The 27 sizes and styles of English reticule appear for the last time in the London Basket Makers' list of 1850. The last workman I know of who had made such work passed away this very year. The coarse brown osier packing and hampers have also been largely superseded by rough cases and casks made from cheap imported timber. English masters did not all, however, whine for protection against the foreigner; the more enterprising set to work to improve the quality and to develop and enlarge the scope of the manufactured articles. Goods of a higher class were produced, such as finely-made chairs, lounges, tables, luncheon and tea baskets, travellers' hampers, so that the lost ground has been more than regained, and a great stimulus has been given to the cultivation of finer kinds of willows.

To two firms this appreciation and improvement of basket work is chiefly due—Mr. W. P. Ellmore, of Leicester, and Messrs. Scott and Sons, of London. Some evidence of these developments is afforded by a comparison of two lists of wages issued by the London Union of Journeyman Basket-makers in 1865 and 1896 respectively. The former consists of 87 printed pages, the latter of 144, and these more closely set. A very large proportion of this increase is due to the inclusion of work first introduced by Messrs. Scott and Messrs. Ellmore.

By the courtesy of Messrs. Scott and Sons, I am able to exhibit some specimens of excellent London work in the shape of luncheon baskets, &c. By a similar favour from Messrs. Ellmore and Sons, I am permitted to show

* Carl Purdy, "Pomo Indian Baskets and their Makers."

some of their London and Leicester work in these chairs, tables, and linen and luncheon baskets.

The main sources of foreign supplies, which in 1901 reached the value of £264,183 were, in the order of their importance — Belgium, Holland, France, Germany, Japan, and Portugal. A remarkable shifting of values has occurred between France and Japan since 1900. In that year from Japan we imported £8,140 value; in 1904 we had increased our imports from that country to £52,377. From France our imports, which in 1900 amounted to £55,870, declined in 1905 to £27,900—a reduction of almost exactly one half. In those years German imports too declined from £33,155 to £22,892—a decrease of about one third. The greater part of this imported work is of a cheap and gaudy nature, and is produced under economic and social conditions I should be sorry to see reproduced in this country. I am proud to be able to say that our craft here in England has been kept out of the hands of the sweater. In certain villages I visited when seeking work in Germany, I found whole families—father, mother and children—working long hours and seven days a week to earn a collective wage of 10s. I well remember the look of amazement that came over the local merchant when I told him the wages I was earning in England. "Gott im Himmel, höre nur zu!" he exclaimed. We have not, nor ever have had, the lightness of touch and neatness which characterise the best French work such as I have seen in some Parisian workshops, but no continental productions approach our best English work in qualities of shapeliness, strength, and durability. Some few years since I invited a Belgian exporter, who had often and importunately sought to supply me, to visit my workshop in order to inspect examples of the English work he would compete with. I placed before him a finely-made linen hamper and a wine flat. He looked; he touched; he despaired. Then throwing up his arms exclaimed, "Ah! jamais un ouvrier belge ne ferait ça." I never saw that Belgian more.

Some grave misconception exists in the public mind, and not a little due to the action of the associations for the welfare of the blind, as to the nature of our craft. Parents, guardians, and charitable folk have often come to me with the halt, the lame, and the blind, believing that basket-making would form an appropriate means for enabling such afflicted lads to earn a living. Need I remark, after what I have said with regard to the necessary native qualities required, that such belief is almost a vain one. The associations referred to undoubtedly serve a charitable and useful function in the social body, and a certain number of partially or wholly blind workpeople are employed in the making of the common kinds of baskets; but the work thus produced is not commercially remunerative, and the associations depend for partial support on the contributions of the benevolent public and on sales of work produced under ordinary conditions and largely imported from the Continent. The work made by the blind is rarely or never exposed in the windows, at least of the shop in Tottenham-court-road. During the past months I have several times inspected their windows, and all the work exhibited there has been of the ordinary cheap commercial kind, the work produced by the blind, which to the expert eye bears obvious traces of its origin, being kept in the background. The results of this policy are that the public is led to believe that the work exhibited is done by the blind, and owing to sentimental reasons it is sometimes preferentially purchased. Certainly the skill and industry of these poor blind folk is admirable, but the work has generally what we term a sore-fingered aspect. The very kindest and most expensive material must be employed, and supplementary assistance in wages is needed if a living is to be earned.

I have referred to the existence of the Basket-makers' Trade Union. It is not so generally known that a Basket-makers' Company still exists in the City of London, and is one of the oldest of the minor trades guilds. In the report of the Livery Companies Commission, 1884, the origin and early history of the Company is said to be lost in obscurity, and in the proceedings of the Court of Aldermen on the granting of livery it is said to have been from time immemorial. All the books and documents belonging to the Company were kept at the Guildhall, and were totally destroyed "in the great and dreadful fire, together with carpets, silver spoons, and other property." It seems probable, say the Commissioners, that the charter may have met with the same fate. However that may be, the Company now exists by prescription and not by charter. The only ancient clue to its existence, says Mr. Hazlitt, is a record of the time of Edward IV., where it is classed with gold and silver wire-drawers and other

foreigners, and its members are restricted to the manor of Blanche Appleton or Chapelleton, now occupied by Fenchurch-street Station and London-street. It is a curious coincidence that the little basement workshop where I learned my craft, and which has been in the occupation of my family for four generations and more than a century, is No. 1, New London-street, on that very Manor of Chapelleton, where the basket-makers of London were settled in the fifteenth century. There seems little doubt, as this early record implies, that in early times the craft was largely exercised by foreigners outside the city, for in the rules and orders of the Worshipful Company of Basket-makers, made by the Court of Aldermen in 1569, it was enacted :—"Item : Forasmuch as at the present time the good men of the same craft are not able of themselves to serve this honorable city with wares unless they have foreigners and aliens to work for them, for a time, until a convenient number of their own apprentices be brought up, taught, and instructed to serve in the same craft, it shall be expedient that every person now enfranchised, shall and may during the space of five years now next ensuing, and no longer, have and keep such foreign apprentices as they now have, and such other foreigners and aliens, cunning and expert in their said craft, if such person cannot have freeman of the said company to serve him." Well, rules are easily made, but foreigners and aliens both in the City of London and in the country generally are and always have been difficult of regulation. I find that thrice five years had passed and foreigners were still with us, for further orders were issued by the Lord Mayor and Court of Aldermen, in 1585, "that it be lawful to keep in work all these foreigners and strangers that we now have, and from henceforth no more to be received in the said craft, and that whosoever enfranchised in the said craft should presume to set any foreigners or strangers on work, who should have left the City, shall have the penalty of the law." But alas! despite the penalties of the law, the stranger within our gates lived and flourished, for in 1610 further orders were made "that no freemen of this city using the trade of Basket-making or Basket-selling shall at any time hereafter buy any manner of made wares of any foreigner using the same trade but such sorts of made wares as of ancient times have accustomed to be bought of foreigners."

I wish I had more time to deal with the curious rules of this ancient art and mystery of the citizens of London — the summary powers conferred upon the warden to enter the workshops and to search, view and oversee, all manner of baskets, flaskets, scryns, maunds, and all other wares and stuff, and to denounce all such as they found unlawful, not well and workmanlike and strongly made, and wrought with good and seasonable stuff, and bring them to the chamber of the city to be forfeited; the heavy fines inflicted on any person of the said craft or fellowship who should rebuke, chide, or brawl with any other person of the said craft; the stringent rules against hawking wares about the city and suburbs; against enticing or inveigling any other man's servant from him by giving or offering any money called drinking money or giving or offering any wages greater than the usual wages. Suffice it to say that this venerable company was amongst 55 companies assessed for corn money in 1603-4, and that although its income and membership are small, it maintains the hospitable traditions of the City. It cannot be described as a bloated company wallowing in wealth. According to Weale's, "London Exhibited" its income in 1851, was only £10. Its income for the ten years under review by the Commissioners of 1884 is said to have averaged £35 a year, "which is chiefly spent on an entertainment." In the accounts for 1878-9, out of an income of £32 16s. 6d., £26 6s. was spent on the annual dinner; in the next year £36 15s. was spent in the same festive manner. The income is wholly derived from fees, for the company has no house or landed property. The number of members in 1884 was 35 freemen, 59 liverymen. At the present time the freemen number 130. The income for 1892 had risen to £102, and for the past decade the company have granted five money prizes, amounting to £11 in all, to the candidates for examination in the department of Technology of the City and Guilds of London Institute—prizes which, I regret to say, I have not always been justified in awarding, owing to the paucity of examinees and the poor quality of the work done.

Having touched on the matter of examination may I conclude by a comparison between the class system initiated by the County Councils of this land, and the old workshop system of training which has prevailed, and still largely does prevail, in my craft. A lad attends a class once or twice a week taken by a more or less competent teacher. He is one of many lads, and is taught straightway to make a certain piece of work, while all around him are other

lads alike fumbling to obtain some command of their material. Now let me describe the boy's training under the workshop system, by my own experience. And here let me make clear that I am dealing with the practical side only. I have no doubt that under the class system much good does and will result from such theoretical tuition as may be possible in the different crafts. Well, then, at about twelve or thirteen years of age the boy is set to work, at first doing odd jobs of sorting and preparing material. He thus obtains a thorough knowledge of the various kinds of stuff, their due preparation and handling. He probably does much of this in the workshop, and whether he does or not, soon enters the shop, and there among a number of competent craftsmen, his training begins. Truly he does not seem to be actually taught very much, but the very fact of his being in the midst of workmen, each with a greater or less mastery of his craft, and working with that emulation, often unconscious, which inevitably obtains where men work together, is a priceless training which no class can afford. Working in this atmosphere of craftsmanship the lad seems to absorb its spirit and grow in the mystery of his art. For some time he is not allowed to make any piece outright, but at length he is set to work on the simpler articles, say a common round or oval basket, and so he is led from simpler to more difficult work and grows to be, if an observant and tractable lad, a trained workman, for all about him are men whose every stroke is an incentive to greater perfection. It would be impossible for him to answer a set of questions in an examination paper with anything like the readiness attained by a class student. He would be hopelessly beaten at that, but he could turn out a workmanlike and finished piece of work pleasing to the eye and useful to the community. I regret to say that my experience of the results of the class system has not been encouraging. For, in truth, excellency of craftsmanship cannot be taught in an art class any more that a fine literary style can be taught in a composition class; that comes only from a familiarity with the masters of literature and severe self-discipline; and it is even so in craftsmanship. To work among, and be insensibly influenced by, masters of the craft is an essential element in the making of a good workman. What the lad sees in a class-room is a number of his fellows all equally inexpert; there is no atmosphere of good craftsmanship; no sense of excellency to bring forth and ripen the flower of perfect art. This fact seems to me not sufficiently recognised in the new industrial training, and I have therefore thought it not out of place to revert to it before closing. Ladies and gentlemen, you cannot learn to be a basket-maker in six lessons at the Albert-hall nor in a few months at a class-room.

DISCUSSION.

Mr. G. Earle asked why it was considered poor workmanship in England to put spokes through spokes for the base of a basket?

Mr. Okey, in replying to the question, said the method was used for very light work, but English workmen thought it was a feeble way of doing their business, because it was not quite so strong. It was perfectly justifiable to use the method, and it was mere prejudice on the part of the English workmen that it was not used.

Mr. Harrison Townsend remarked that the reader of the paper had described, without going too much into the archæology of the subject, an art and a craft which had been carried on from the Fifth Dynasty down to the present day, and had explained in not too technical language the different methods employed then and now in the craft. He had brought under notice its continuity, and had put forward a very just and fair claim to its being recognised as perhaps the oldest technical and craftsmanlike process in existence. A few weeks ago the speaker had the opportunity of seeing some of the modern basket work of Europe on show at the Milan Exhibition; but the samples and specimens which were exhibited that evening were much finer specimens of art and workmanship than the modern French, Italian, and Austrian examples exhibited in Milan. If it had done nothing else, the paper had shown that there was still one craft which, in its English manifestation, was worthy of all respect, and for that reason he desired heartily to thank Mr. Okey for his instructive paper.

Lieut.-Colonel Allan Cunningham remarked that Mr. Okey had spoken with enthusiasm of his craft, describing it as a handicraft which could be essentially carried out by hand with a few and simple tools, and was therefore very valuable as a home industry. He was afraid, however, it would not be suitable for the unemployed—or, at any rate, for those who were unemployable—because the handicraft evidently required great skill, training, and apprenticeship for its proper accomplishment. Mr. Okey had given a most interesting account of the apprenticeship system in vogue in the basket trade. He was sorry to find that the apprenticeship system was falling out of use in England, very few boys being apprenticed

nowadays. Much higher wages were now offered to boys as newspaper hawkers, runners, and letter carriers, a most unfortunate state of things, because the boys were thus tempted away from learning a handicraft which would be the means of earning them a living in after life. When the boys grew up, they were dismissed from their employment as hawkers and letter carriers, and were unable to earn a living wage. In the eyes of an enthusiast, basket-making was not merely a handicraft, but had been called by the author an art, the basket-maker being an artist. Certainly the specimens exhibited were of a most beautiful character, and brought home the truth of the author's statement in that regard. Even cheap basket work had its uses. Mr. Okey had mentioned two principal materials as being in use in England, the osier and the cane, the former being indigenous and the latter imported. It was a very curious circumstance that an imported material should be capable of being so extensively used, and that such great skill should have been obtained in its use as a trade as to absorb nearly half the quantity of the material grown. Rushes and bamboo were also useful for basket-making. Mr. Okey had referred to the latter, but had not mentioned the great importance of it. In those countries in which bamboo was indigenous, it was a material of extreme importance to basket-makers, all sorts of things more or less of the nature of basket work being made from it. For instance, a sort of basket work formed the walls and floors of many huts. The bamboo was simply beaten flat, and then roughly woven together to form the walls and the floors. All sorts of rough baskets were made from it, the coarser qualities only being made because it was not the kind of material that lent itself to fine weaving, being too harsh. One of the most interesting parts of the paper to the non-professional man was the part dealing with the ancient history of the basket, the slides exhibited showing the forms of ancient basket work being most interesting specimens. The Chairman, in inviting discussion had hinted that possibly members of the audience might desire to correct the author in some of the statements he made. Personally he thought that was impossible, because he could only give unqualified praise to Mr. Okey for his paper.

Mr. H. B. WHEATLEY desired to refer to two points mentioned by Mr. Okey. The illustrations of basket work in architecture taken from Ruskin's "Stones of Venice," were very valuable, and he might note the fact that much of Saxon art consisted of an imitation of basket work. It would probably be within the knowledge of those present that the ornamentation of most of the designs on the Saxon stone coffin tops in Peterborough Cathedral, had their motive in basket work. The second point was, that he thought the "foreigners" to whom Mr. Okey had referred could hardly be called aliens, because he believed the term "foreigner" merely meant someone not a freeman of the City of London. In all documents of the City Companies, the term "foreigner" meant an individual coming from outside the City, but in certain instances the word "stranger" might represent an alien. He was sure that Mr. Okey's interesting and valuable paper dealing with the history of an art of which very little was known had been highly appreciated.

Mr. H. A. LEE, as a member of the London Union of Journeyman Basket Makers, desired, on behalf of his shopmates, to thank the Society for being allowed to be present and listen to Mr. Okey's interesting paper, which was true to life in the trade as they knew it.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his most interesting and helpful paper, remarked that his own interest in basket-making was mainly in its connection with pattern weaving. Mr. Okey had called basket-making the parent of weaving. It was undoubtedly the primitive form of weaving; some people even called it the primitive form of all pattern design, and he was not sure that that was not the case. He had been particularly interested in what the reader of the paper had said about his craft. It was delightful to hear that a man could nowadays earn a good living at basket-making, and that there was still a craft in existence where a man would sing at his work. Apropos of Mr. Okey's statement that his family had sprung up in the district where basket-making was made, and had been there for many generations, and to his reference to aliens, he could not help wondering whether the author, who spoke so fluently in many languages, was one of the descendents of those very desirable aliens. He was in entire agreement with Mr. Okey's remarks on the difference between class and workshop teaching. A handicraft could never be taught in a class as it was in a workshop. Technical classes, as Colonel Cunningham had said, were only a very poor attempt to make up for the lack of apprentices. It was the fact that every man had to learn his trade, and a trade could not be learned, as Mr. Okey had very rightly said, in six lessons at the Albert Hall. One reason perhaps why the pupil in classes did not learn a trade as well as in the workshop was that in the class, where he might be doing very little that was to any purpose, he was doing it with others who did it perhaps to less purpose still. He could therefore imagine himself a clever fellow, he got a swelled head, and that meant the end of him as a workman. On the other hand, in a workshop a youngster worked with older workers, and it was no use giving himself airs or fancying he was a great man. If he did so he would soon get it knocked out of him, and be brought very quickly to his level. The basket work exhibited was for the most part very good from the point of view of design; but he would like to ask whether there was any reason why basket work, as it was

seen generally in the form of chairs and tables, should be so wobbly, and why a little more quiet and restraint in the forms of basket work could not be introduced. He did not see why basket work should be made in the form of Austrian bent wood.

The resolution of thanks to Mr. Okey was then put, and carried unanimously.

Mr. OKEY, in reply, thanked the audience for the vote of thanks, stating that he was very pleased to find that his paper had aroused so much interest. With regard to Colonel Cunningham's remarks, it was an undoubted fact that a good many rush baskets were made, and he ought to have referred to them in his paper. It was not, however, a very important section of English work. A good many rush baskets were imported from Italy but they were not very valuable. Plaited rush was very much used in the manufacture of such articles as luncheon baskets and chairs, but he did not bring any specimens with him, because they gave one the impression of looking rather "gouty" as it was called in the trade. Personally he did not like plaited rush work very much. With regard to bamboo, he was always amazed every time he saw Japanese work to find what could be done with that stubborn article. Nearly all Japanese work was made out of bamboo skeins. Mr. Wheatley had referred to the use he had made of the word "foreigner." The point which had struck Mr. Wheatley had also struck himself when he first saw the reference to the word in the excerpt from the statute of Edward IV.; but when he found that the words "foreigners" and "aliens" were also used a few years later, it seemed to him there could be no doubt they did actually mean a foreigner. There was no doubt that, all through the history of basket-making, a good deal had been learned from foreigners. From mediaeval times even up to the present day the word "foreigner" in certain parts of England simply meant a stranger from outside. For instance, in a hop picking village where he lived some time ago, the native hop-pickers spoke of the people who came in from outside as foreigners or strangers. He had endeavoured to get a sight of the statute of Edward IV., but as Mr. Hazlitt did not give the reference in his book he could not find it. Of course everything depended upon the Norman French or Latin word used to convey the term "foreigner." With regard to the Chairman's point as to the form of basket chairs and tables, he did not at all defend the attempts made to imitate Austrian bent wood, but that terrible thing, commercialism, governed all trade productions. Certain makers wished to improve on the patterns of other makers and to do something else, and that was responsible for what had occnrred. The actual craftsmanship, however, was very good, the basket work in the chair and linen basket exhibited being of the most excellent character.

GLEANINGS FROM THE BRITISH RAILWAY RETURNS FOR 1906.*

There is very little of an absolutely new character in the returns for 1905, which, save for some slight addional information respecting electric railways, follows the lines of immediately preceding reports. If the present commission on railway statistics makes any drastic recommendations, it is difficult indeed to conceive how such recommendations can bear any fruit until the returns for 1907 are available. Regarding the returns for 1905 as a whole, these present one or two encouraging features, manifesting the fact that attention is being given to such subjects as the loading and idle mileage of goods trains. Otherwise slight increases in capital outlay are to be chronicled, accompanied by slight increases in gross earnings, and the accustomed decrease in the second-class passenger. Taking these and other matters in their order, the following facts are of note:—

Capital.—The total paid-up capital at the end of 1905 amounted to £1,282,800,000, an increase of £14,300,000 over 1904. Of the total capital, £194,300,000 represents nominal additions due to the consolidation, conversion, and division of stocks. The average dividends paid on the various classes of capital in 1905 were almost exactly the same as those paid in 1904, being approximately 3¼ per cent. on the ordinary capital, 3½ per cent. on the preference, 4 per cent. on the guaranteed, 4 per cent. on the loans, and 3½ [per cent. on the debenture stock. The average rate of dividend or interest computed on the total capital, as it would have stood if no nominal additions had been made thereto, was 4·05 per cent. as compared with the rate of 3·43 per cent. mentioned above. In like manner the proportion of net earnings to capital, exclusive of the amount of nominal additions, is 3·99 per cent.

Traffic Receipts from Passenger Traffic.—The passenger traffic earnings amounted in the aggregate to £48,720,000, an increase of £332,000 over 1904. There is a marked decrease in second-class earnings, excluding season ticket holders, of £211,000, attributable in part to the abolition of this class on the Metropolitan and Metropolitan District Railways consequent on their electrification, and in part due to a reclassification of the revenue of the Liverpool Overhead Railways, where the cheaper of the two classes was formerly classed as "second" but now as "third." The total number of ordinary passengers carried was 1,199,022,000, of whom 1,110·0 millions were third-class, 52·6 millions second-class, and 36·4 millions first-class. The average receipts per ordinary passenger were, third-class 6·5d., second-class 8·8d., and first-class 23·7d. The number of season-ticket holders is reckoned on the equivalent annual tickets as individual tickets are issued for varying

* Abstracted from the "Returns of the Capital, Traffic, Receipts, and Working Expenditure of the Railway Companies of the United Kingdom for the Year 1905." (Cd 3106.) Printed by Wyman and Sons, Ltd., Fetter-lane, E.C Price 1s. 3d.

terms. These amounted to 129,893 first-class (a decrease of 896), 157,685 second-class (a decrease of 11,587), and 275,462 third-class (an increase of 31,650). The receipts per annual season ticket were, first-class £11 2s., second-class £6 10s., and third-class £4 8s.

Goods Traffic.—The traffic receipts from the carriage of minerals, merchandise, and live stock increased during 1905 by 1,012,000 to £56,412,000. The weight of minerals conveyed was 358·1 million tons, and of general merchandise 101·1 million tons. In the case of minerals, the proportionate increase in weight is approximately the same as that in receipts, but that in the case of general merchandise the rate per cent. of increase is nearly twice as great in the weight as in receipts, viz., 2·8 per cent. as against 1·5 per cent.

Train Mileage.—Although information is still lacking as to ton-mileage and passenger-mileage statistics, particulars are given which show that the mileage of passenger trains was 244·4 million as against 240·0 million miles in the preceding year. With regard to the goods traffic, the train mileage amounted to 154·8 million tons as against 155·2 million tons in 1904. The efforts made to reduce goods train mileage resulted in a decrease of 400,000 miles, following on decreases of 4,500,000 miles in 1904, and 10,000,000 miles in 1903. This result in 1905 has been achieved in the face of the increased tonnage of goods carried, amounting to 11,300,000 tons, the figures thus continuing to indicate an increase in the average load of goods trains. With regard to passenger train mileage, however, there was an increase of some 4,400,000 miles in 1905, although the total number of passengers carried was approximately the same as in 1904, the indication in this case being that the companies were placing greater facilities at the disposal of the travelling public. The receipts per passenger train mile were 47·58 pence, a decrease of 0·51 pence on the 1904 earnings, these being the lowest passenger train earnings since 1888. Goods earnings per goods train mile reached the record figure of 87·29 pence, an advance of 1·87 pence on the 1904 earnings, and an advance of 16·23 pence since 1900. This is attributable to the better loading, longer trains, and more powerful engines.

Working Expenditure.—The proportion of working expenses to gross receipts was again 62 per cent. The total working expenses of 70·06 millions sterling were actually £890,000 greater than in 1904. The expenditure on "Maintenance of Way, &c.," decreased by £10,000, as against increases of £70,000 in 1904, and £320,000 in 1903. That on "Repairs and Renewals of Carriages and Waggons" increased by £130,000 in 1905, as compared with £50,000 in 1904, whilst "Traffic Expenses" increased by £110,000, as against £120,000 in 1904. The expenditure for "Locomotive Power" (including repairs and reuewals) which showed a falling off of £820,000 in 1902, £180,000 in 1903, and £30,000 in 1904, showed a slight increase of £20,000 in 1905. Taking the above four principal heads of expenditure together, the total increase amounted to £250,000, which compares with an increase under the same heads in 1904 of £210,000. Of the remaining heads of expenditure, the increase in the "Miscellaneous" expenditure, including steam-boats, docks, &c., amounted to £350,000.

Increase in Rates and Taxes.—The total amount paid in rates and taxes in 1905 was £4,933,000, an increase of £197,000 over 1904. The increase since 1896 has been £1,784,000, or about 56 per cent. This latter item has now become of serious importance. Reckoning its cost per train mile it amounts to 2·95 pence out of the average total cost per train mile of 39·79 pence.

THE GERMAN POTASSIUM INDUSTRY.

Germany enjoys the distinction of being, so far, the only country in which potassium salts, called kali, have been discovered in very large quantities, and can be said to possess a monopoly of these valuable mineral deposits. The year 1905 was, according to the American Consul at Brunswick, the most prosperous in the history of the potassium mining industry. The feeling of security produced by the renewal of the potassium syndicate in 1904, for five years, and the continuous increase in the sales of the old mines, and their immense profits, have led to the organisation of a great number of new mining companies. Kali is exported from Germany in large quantities, and is used principally for fertilising purposes in the cultivation of cotton, tobacco, sweet potatoes, oranges, and other fruits and crops. The amount of kali, or potassium salts, produced by the mines, amounted in the year 1879 to 661,700 tons. In 1904, the amount produced had reached 3,939,518 tons. The principal part of this increase consists of so-called manure salts for agricultural purposes. The large export to other countries, and the exhaustion of land surfaces by active cultivation at home, increase the demand for these salts, and show that they are becoming a necessity. Three States are represented in the potassium syndicate—namely, the Kingdom of Prussia, and the Duchies of Brunswick and Anhalt. Besides it present holdings in the syndicate, the Prussian State Treasury for Mines, has bought for £1,500,000, the valuable Hercynia mine at Wernigerode. The object is to strengthen Prussia in the syndicate, and to give it a predominating influence in the present state of the industry. It is said that the purchase of other mines is contemplated by the same Government. Brunswick is represented by the Asse Mine, which was leased to the syndicate for twenty-five years, from 1879, at the annual rental of £10,000. It is provided in the contract that if the rental falls below that amount for three successive years the lease can be cancelled by the State. On the other hand, the State is prohibited by the contract from granting mining claims to outside parties during its continuance, or

exercising the right of opening mines itself during that period. The year 1905 has been called "founding year" in the potassium mining industry. The fever of organising new companies during the year reached such a stage as to threaten the stability of the syndicate, and to cause serious apprehensions as to the future prices for the products of the mines. In order to restrain this speculative activity, a law was passed by the Prussian legislature limiting the granting of mining claims for coal and kali to two years. On account of this measure speculators transferred their sphere of activity to the State of Hanover, where mining claims are not subject to this law. The result is that scarcely a spot of ground remains open which is not covered by a mining contract for potassium. The number of companies organised during the year is said to have reached considerably over 50. The geological formation in which the mining operations are carried on is sand interspersed with strata of water-bearing gravel. This formation makes mining extremely hazardous owing to exposures to caving and flooding. Under the Prussian law the dimensions of a maximum claim for which mining rights may be granted is about 500 acres. A potassium mine before it becomes profitable usually costs from £250,000 to £300,000. In searching for new sources of revenue the proposition has lately been brought before the tax committee of the Reichstag to levy an export duty on potassium salts. The proposition has been supported by the Landwirthschaft, or agricultural party, as a means of protecting German agriculture from foreign competition, while it has been opposed by the potassium syndicate on the ground that the salts are little used in the cultivation of foreign wheat, the chief article of competition, and that the tax would be difficult of collection and highly injurious to an industry engaged in exporting a valuable article of commerce. The committtee has recently rejected the proposition and removed a disturbing factor from the industry. From time to time reports are published of the purchases of large interests in potassium mines by English and American capitalists. There is no doubt that such purchases have been made, but it would be difficult to ascertain their extent. It is generally understood that the majority of the shares of the mine "Einigkeit," one of the less important members of the syndicate, is controlled by American capital. At the beginning of the present year it was stated on good authority that a majority of the shares of the mining property, "Solling," had been acquired by English investors, and that previous to this acquisition large purchases had been made by English capitalists in the mining companies, Wallensen, Thuisten, and Duingen.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in October :—

New Charts.—3598—The World :—Lines of equal magnetic dip 1907. 3603—The World :—Mean lines of equal horizontal force 1907. 1406—North sea :—Dover and Calais to Orfordness and Schevenigen. 3596—South America, Magellan strait :—Puerto Zenteno (Pecket harbour); Canal Tortuoso; Laguna Baja. 40—India, west coast :—Karáchi harbour (Kurrachee). 3581—India, east coast :—Approaches to Pámbam pass. 3597—Gaspar strait :—Approaches to Tanjong Pandan. 3037—Korea, Port Lazaret and Yung hing bay; on Shan Tin (Gensan bay). 2387—Japan :—Io jima to Madara jima, including Hirado shima. 3591—Japan :—Iburi wan or Uchiura wan (Volcano bay).

New Plans and Plans added.—160—Plans on the west coast of Italy—New plan :—Mouth of the Tiber. 2761—Sumatra, west coast; Chingkuk bay to the strait of Sunda. New plan :—Silabulabu anchorage. 912—Anchorages in islands off the north-west part of New Guinea. New plan :—Labuha road. 2193—Celebes; sketch plan of anchorages between Mindanao and Celebes. Plan added :—Esang bay. 1592—China, east coast; Yung river and approaches. Plan added :—Ning po anchorage. 3375—Plans on the south coast of Japan. Plans added :—Mimitsu anchorage; Oryuzako anchorage. 2467—Plans of anchorages on the north coast of New Guinea. New plan :—Matterer bay.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—30—England, south coast :—Plymouth sound and the Hamoaze. 1951—England, west coast :—Liverpool bay. 3021—England, east coast :—River Medway between Pinup and Chatham reaches. 3177—South Polar chart, showing tracks of vessels and discoveries. 2840—British Columbia :—Haro strait and Middle channel. 1697—Africa, west coast :—Garraway point to Growa point. 1003—Africa, east coast :—Pungue river; Beira harbour. 8c—Red Sea. Sheet III. 81—Red Sea :—Merser Durúr to Trinkitat, showing the approaches to Sawákin. 136—Bay of Bengal, river Húgli :—Sangor point to Calcutta. 1761—China, east coast :—Ockseu islands to Tung Yung.

These charts are issued by Mr. J. D. Potter, 145, Minories.

COTTON GROWING IN THE WEST INDIES.

Sir Alfred Jones, K.C.M.G., President of the British Cotton Growing Association, has offered two gold medals for competition amongst Sea Island cotton growers in the West Indies, that is one for growers of ten acres and over, and one for growers of less than ten acres. These medals are to be awarded on the crop results for 1906. Sir Daniel Morris reports that this year the total crop of Sea

Island cotton in the West Indies is of the estimated value of £140,000, and it must be remembered that the industry is not yet five years old.

In connection with this offer of medals, it is interesting to note that the Society of Arts attempted, soon after its institution, to encourage, by means of the offer of medals, the growth of agriculture in the Colonies. In 1768, a gold medal was offered "For the best specimen, not less than 10 lb., of cotton produced in the British dominions in America, equal to the fine Brazilian cotton to be produced, with certificates of the place of growth, on or before the first Tuesday in January, 1770."

This offer was annually repeated until 1777. In 1778, the gold medal was given to Mr. Andrew Bennet, of Tobago, for the best specimen of West India cotton. Mr. Bennet sent an account of his experiments and observations, which is printed in the *Transactions*, vol. 1, p. 254.

THE LIBRARY.

The following books have been presented to the Library since the last announcement:—

Australia, Year Book of, 1906.—Presented by the Agent-General for New South Wales.

Banaji, Khoshru N.—The Simplex Shorthand in Theory and Practice. Bombay: "Times" Press. 1906. Presented by the Author.

Bayley, R. Child.—The Complete Photographer. London: Methuen and Co. 1906. Presented by the Publishers.

Beadle, Clayton.—Chapters on Papermaking. Vol. II. London: H. H. G. Grattan. 1906. Presented by the Author.

British Rainfall, 1905.—Compiled by H. R. Mill, D.Sc., LL.D. London: E. Stanford. 1906. Presented by the Compiler.

Bushell, Stephen W., C.M.G., M.D.—Chinese Art. Vol. II. London, 1906. Presented by the Board of Education.

Caven, R. M., D.Sc., and G. D. Lander, D.Sc.—Systematic Inorganic Chemistry. London: Blackie and Son, Ltd. 1906. Presented by the Publishers.

Christie, Mrs. A. H.—Embroidery and Tapestry Weaving. London: John Hogg. 1906. Presented by the Publisher.

Crookes, Sir William, D.Sc., F.R.S.—Select Methods of Chemical Analysis, chiefly Inorganic. Fourth Edition. London: Longmans, Green and Co. 1905. Presented by the Publishers.

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HOME INDUSTRIES.

The Channel Traffic.—This is not the place to discuss the political considerations that must weigh with those who have to decide whether there is to be a tunnel between England and France, but it may not be out of place to note its probable effect upon British imports into France. In the opinion of many experts they would be greatly helped by through land communication. And this opinion seems to hold in France as here. "Imagine," said a French manufacturer quoted by the *Pall Mall Magazine*, "a train steaming direct from Manchester into the Gare du Nord. It could bring any quantity of cotton and woollen fabrics from the north of England, which could be sold at a price inferior to our own, or at least not superior. The only reason why a larger trade is not at present done with England is because of the lapse of time between the giving of an order and its completion. Roughly, you may say, it takes a week to get any given article from England; but if the goods came by train, with only two handlings, this time could be reduced to a third, or even less." Assuming this forecast to be sound, and accepted by British manufacturers, it does not of course, necessarily follow that the tunnel ought to be cut. The security of the kingdom must be the first consideration; but probably what may be called the trade argument will figure largely in coming discussions.

Shipping in 1906.—The past year saw the largest addition to the British mercantile marine ever made in twelve months. The effective tonnage was increased by about 1,000,000 tons of dead weight-carrying capacity, the total addition to the register being 1,550,000 tons. The merchant steamers turned out of the shipyards represent 1,800,000 tons gross, an addition of 12½ per cent. upon the production of 1905. The way in which ship builders were able to induce ship managers to order tonnage was remarkable. Although the majority of ship managers were able to do no more than cover the depreciation of the steamers entrusted to their care, orders for larger vessels were placed whenever a steamer was sold or lost, or the freight markets showed any signs of a profitable level approaching. This readiness to build is generally assumed to be due to the prosperous condition of the industry, but Messrs. Angier Brothers, in their steam shipping report for 1906, suggest that it is rather owing to the fact that other outlets for capital are becoming more circumscribed, and that the over-sea carrying is the one trade which it has been impossible to surround with a tariff wall. Be that as it may, the Americans and French seem content to let the British do their ocean carrying if they can secure the profitable work of growing and manufacturing the cargo. The American mercantile marine grows only slowly, notwithstanding subsidies, and the French marine is less than one-tenth of the British, though heavy subventions are paid. The German fleet is the second largest in ocean ships with 3,810,000 tons, but of 2,081,000 net register tons of steamers, 1,081,568 tons are owned by five great lines, which, besides receiving large payments for carrying the mails, are preferentially treated by the Government railways in regard to both goods and passengers.

The Iron and Steel Trades.—Whilst here and there some branch of the iron and steel trades—as for example, the boiler-makers—complain that it has done less well than others, collectively the trade has seldom done better than in 1906. To quote from the annual record of the situation made by Messrs. Billing and Lowe, "the general result of 1906 may be taken all round as very satisfactory, and those countries whose staple industries are the production of iron and steel, and the cultivation of allied trades, have had a time of exceptional prosperity." The output of pig iron in the year is put at 11,000,000 tons an excess of 2,600,000 over the figures of 1905. Prices have risen some 20 per cent., Middlesboro' No. 3 from 53s. 3d. to 63s. 6d. and West Coast hematite from 71s. 6d. to 80s., but the prices of manufactured iron and steel remained practically unchanged. Not only was the past year an exceptionally good one for most branches of the trade, there is reasonable ground for the belief that 1907 will also be a very good year. Many firms are practically assured of big returns, owing to the extent of their engagements ahead, and as these engagements are mostly based on the high values of last year, profits are likely to be larger than in 1906 seeing that part of the work of last year was done at contract prices fixed before the rise in the value of raw materials had taken place.

Railway Dividends.—The past half-year has on the whole been a good one for the railway companies. Higher receipts, as compared with the corresponding six months of 1905, were general, and in most cases improved dividends may be anticipated, the exceptions being the Great Central, South Western, and London Brighton and South Coast, due in the first case to new capital charges, and extra expenses due to the opening of the new Great Central and Great Western joint lines, and the new agreement with the Metropolitan; in the second to the Salisbury disaster, and in the third to the charges on new capital. Naturally the lines associated with the great industrial centres have benefited most, the North Eastern leading the way with an increase in gross receipts of something like £300,000. Speaking generally, and excluding London local railways, the ncrease in receipts has been substantial. On the other hand expenses have absorbed much of the increased revenue. Materials and labour have cost more, rates and taxes continue to advance, though less rapidly, thanks to successful appeals to the courts, and the South Western and Great Northern Railways have to face heavy "compensation." Still the extra net profit in most cases should be appreciable. It is noteworthy that the railways more especially dependent upon the pleasure travel of

Londoners have done less well, and the ordinary stocks of London local railways are quoted at a discount—often a heavy one. The "tubes" are not financially successful. They have done much to relieve congestion in the streets; but they do not, and are not likely to, give an adequate return upon the capital employed. The Central London has done the best, but it has never paid more than 4 per cent. on its ordinary stock. Nor has the electrification of the Metropolitan and District Railway improved its financial position. Capital charges have been seriously increased without any compensating improvement in the revenue. The prospectus issued by the Great Northern and City (in 1898) estimated net revenue at £81,500, and a second prospectus issued in 1904, immediately before the line was opened, put it at £79,680, but the reality has, so far, fallen far short, the actual results for the year to June 30th last, showing a net revenue of only £46,722. The London railways have to reckon with exceptional difficulties. Rates are unusually heavy—the Central London pays £32,000 a year in rates and taxes, equal to 1 per cent. per annum on the ordinary stock—the competition of road vehicles having free use of the roads, and paying nothing to the cost of widening, is very severe, and whilst the capitalisation per mile of line is unusually high, fares are exceptionally low.

Banking Results.—With a margin of 2 per cent., between the Bank rate and the rates paid on deposits the banks are doing well just now, and although the dividends declared for the six months just ended are not larger than those for the corresponding period of 1905 there has been increase in the profits earned. The London and Westminster Bank has increased its profits for the six months by some £41,000; the London Joint Stock Bank by over £40,000; the London City and Midland by £21,000; William Deacon's Bank being the only one which has substantially increased its dividend for the whole year, as from 13¾ per cent. to 15 per cent. In giving the figures of the clearings for 1906, the secretary of the Bankers' Clearing House says that for six successive years the yearly totals of the paid clearings have exceeded all previous totals, "a sequence only equalled in length by the years 1868 to 1873, in the last year of which the total was less than half the year's total for 1905." Yet the increase for last year was £423,399,000, or 3·4 per cent., as against an increase in the previous year of £1,723,738,000, or 16·3 per cent.

The Wool Trade.—As in so many other cases, the past year was very favourable for the producers of the raw material, but if 1906 was pre-eminently a year for the growers, makers have been very active. The rise in the price of wool in recent years has been remarkable. Wool that five years ago could be bought for 4d. per lb. cannot now be got at less than 14d., and it looks as if the highest point has not been reached. It was supposed that the increasing supplies from Australia would lead to a fall in prices, and many Bradford importers sold forward at as much as a penny less than current rates, but the demand kept pace with the supplies, and to-day stocks are pretty well exhausted. And all descriptions of home-grown and colonial wool have shared in the demand, cross-bred wools, which were thought certain to fall away from their high level, having touched a higher point than for a generation. Bradford is busier than at any time of the year, which is saying much, and expert opinion points to a continuance of the good times.

The Rubber Trade.—It is a little surprising that, having regard to the rapid growth of the cycle and motor industries, with their rubber requirements, the imports of rubber last year were a trifle less than in 1905—21,269 tons as against 21,700 tons—and that the highest quotations have not been quite maintained. Fine grades of Para, Bolivian, and Peruvian show a decline of 2d. on the year. Opinions differ as to the future. The world's supply increased from, roughly, 60,000 tons in 1905 to 65,000 tons last year, but all was absorbed. Increased supply has met rising consumption but that is all, and it is difficult to believe that it will do more in the immediate future. Additions are constantly being made to the area under cultivation. In Ceylon, Malaya, Malacca, and Sumatra, Java, Borneo, Nicaragua, Honduras, Brazil, the West Indies, considerable areas have been planted with rubber recently, but it must be some years before their produce materially affects the market, and meantime it will be becoming increasingly difficult to get uncultivated rubber. But that ultimately, and before very many years have passed, supply will get ahead of demand is probable, notwithstanding that the supplies from some sources are steadily decreasing. There is little possibility of new rubber-producing areas being discovered that would seriously affect the market, but the cultivated area is certain to rapidly extend. Rubber can be grown in nearly all tropical lands, and at anything like present prices it can be made to yield a large profit. It is not difficult to grow, the drawback, from the point of view of the ordinary settler being the time that elapses before a plantation comes into profitable bearing. But after all it is not much, if any, longer than the time taken by a cocoa plantation to mature, and once established, it will return not only a handsome profit upon outlay, but one assured for many years. It would seem to follow that the area under cultivated rubber must continue rapidly to increase whilst prices remain upon anything like their present level.

GENERAL NOTES.

British Trade with Switzerland.—Mr. J. C. Milligan, British Commercial Agent in Switzerland, is of the opinion, as stated in his Annual Report on the Trade of Switzerland (Cd. 2682), that the United

Kingdom might largely increase her exports to Switzerland if British manufacturers went the right way to work. It is pointed out that while Switzerland sent us, in the year under review, her manufactured goods to the value of £6,953,000, we were only able to send her our finished goods to the amount of £2,146,000, so that there was a difference of £4,800,000 in favour of Swiss commerce between the two countries. It is true that the British exports to Switserland of cotton yarns and textiles reached last year £1,242,000, but the light returns we can show in the exports of all other finished goods is £904,000 out of a total of more than £17,000,000. Mr. Milligan is confident that a larger trade could be done by British exporters if they would conform to the custom of the country and be willing to sell to both the large and small retailers. And he seems to think that the United Kingdom is insufficiently represented by commercial travellers. In 1905 no fewer than 4,838 German commercial travellers visited Switzerland, the German percentage of the total imports to Switzerland being 53·2 per cent. On the other hand, there were only 53 travellers from the United Kingdom, and the percentage of imports from the United Kingdom was only 11.

CUBA.—The growth of population in Cuba since the war with Spain is remarkable. In his report on the trade of the island just issued, Mr. Vice-Consul Griffiths gives the figures. According to the census of 1899, the population in the year numbered 1,572,797; in January of the present year it had increased to 1,878,951; the death-rate being only 14·38 per 1,000 inhabitants; but in Havana 21·20. Immigration shows large and constant increase in the same period. In 1900 the immigrants numbered 19,110; in 1905, 54,219. Railway construction is proceeding apace, and the Vice-Consul reports that there is a good opening in Cuba for the supply of cheap, serviceable standard narrow gauge cars for carrying sugar-cane in bulk, the orders for the majority of these at present going to the United States. There is also a demand for ox or horse-cart weighbridges, which are used for the purpose of weighing the cane before delivering to the railway companies. The United Kingdom maintains her supremacy in the shipping going to Cuba, but 46¾ per cent. of the imports of 1905 came from the United States; the United Kingdom being second with 17½ per cent. The total commerce of the island amounted to £41,025,000 as against £33,208,000 in 1904, an increase only of 23½ per cent.; imports and exports having gained in practically the same ratio.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 16, 1907.—Adjourned Discussion on Mr. J. W. GORDON's paper, on "Patent-law Reform." SIR WILLIAM PREECE, K.C.B., F.R.S., will preside.

JANUARY 23.—"The Isthmus of Panama." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company. SIR JOHN WOLFE-BARRY, K.C.B., F.R.S., will preside.

JANUARY 30.— "Apprenticeship." By JAMES PARSONS, M.A. SIR WILLIAM BOUSFIELD, M.A., LL.D. will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 24.—"The Bhils of Western India." By CAPTAIN E. BARNES, Indian Political Department. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

FEBRUARY 14.—"The Practical Side of Famine in India." By SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., late Chief Commissioner of the Central Provinces.

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

JANUARY 15.—"The Progress of the Uganda Protectorate." By GEORGE WILSON, C.B., Deputy Commissioner Uganda Protectorate. Colonel SIR FREDERICK D. LUGARD, K.C.M.G., C.B., D.S.O., will preside.

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

JANUARY 29.—"Artistic Treatment of the Exterior of the Pianoforte." By WILLIAM DALE, F.S.A. T. G. JACKSON, R.A., will preside.

FEBRUARY 19.—"Joinery and Furniture Making." By A. ROMNEY GREEN. HALSEY RICARDO will preside.

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

LECTURE I.—JANUARY 28.—*Alluvial Gold Mining.*—Small scale methods and manual appliances—Hydraulic sluicing — Gold dredges; chief types; ground to which suitable; costs—The deep leads of Australia; their nature; distribution; methods of discovery and mining.

LECTURE II.—FEBRUARY 4.—*Lode Mining.*—The term "reef" used both for ore and "country" rock—The chief types of gold-bearing lodes—The importance of ore genesis in reference to mine development—The chief gold fields of the world and their structures—The Rand and its banket.

LECTURE III.—FEBRUARY 11.—*Gold Production.*—The crushing of the ore; the stamp mill—The extraction of gold by amalgamation; smelting; chlorination and cyanidation—Reforms in consequence of the tube mill and the filter press—The depth of ores; surface and secondary enrichment—Mining costs and gold mining organization.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S, "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 14...Surveyors, 12, Great George-street, S.W., 8 p.m Discussion on Paper by Mr. E. H. Blake, "Some Notes on Sanitary Law."

Geographical, University of London, Burlington-gardens, W., 8½ p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. J. Masterman, "Some Recent Developments in the British Constitution."

TUESDAY, JAN. 15. SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) Mr. George Wilson, "The Progress of the Uganda Protectorate."

Asiatic, 22, Albemarle-st., W., 4 p.m. Dr. Grierson, "Modern Hinduism and its Debt to the Nestorians."

Hellenic Studies, Society of Antiquaries, Burlington-house, W., 5 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Percy Gardner, "The Sculpture of Ægina in relation to Recent Discovery." (Lecture I.)

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. Mr. E. E. Fournier D'Albe, "The Application of the Electron Theory to Electrolysis."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. Francis Fox's paper, "The Simplon Tunnel."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. E. B. Sargant, "Federal Tendencies in Education."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, JAN. 16..SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Adjourned Discussion on Mr. J. W. Gordon's paper, on "Patent-law Reform."

Meteorological, 25, Great George-street, S.W., 7½ p.m. (Annual Meeting.) Address by Mr. Richard Bentley (President), "Weather in War Time."

Microscopical, 20, Hanover-square, W., 8 p.m. (Annual Meeting.) 1. Address by the President, "The Flowering Plants of the Mesozoic Age." 2. Exhibition by Mr. Rousselet of mounted specimens of fresh-water polyzoa.

United Service Institution, Whitehall, S.W., 3 p.m. Major R. A. Johnson, "The Swiss Militia System."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, JAN. 17..Antiquaries, Burlington-house, W., 8½ p.m.

Royal, Burlington-house, W., 4½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. W. Botting Hemsley, "*Platanthera chlorantha*, Custor, var, *tricalcarata*." 2. Paper by the late Mr. C. B. Clarke, "Acanthaceæ of insular Malaya." 3. The Rev. T. R. R. Stebbing, "A Freshwater Isopod from Calcutta."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. A. W. Stewart, "The Relation between Absorption Spectra and Optical Rotatory Power. Part I. The Effect of Unsaturation and Stereo-isomerism." 2. Mr. F. S. Kipping, "Organic Derivatives of Silicon. Part II. The Synthesis of Di-ethyl Propyl Benzyl Silicol, its Sulphonation, and the Resolution of the Sulphonic Derivatives into Optically Active Compounds." 3. Messrs. J. J. T. Hewitt and T. F. Winmill, "The Association of Phenols in the Liquid Condition." 4. Mr. J. T. Hewitt, "A New Mercuric Oxychloride." 5. Messrs. S. Smiles and T. P. Hilditch, "Aromatic Selenonium Bases." 6. Mr. A. G. Green, "The Relation of Colour and Fluorescence to Constitution." 7. Mr. E. Divers, "The Constitution of Silver Nitrite; a Correction." 8. Messrs. F. D. Law and F. M. Perkin, "Preparation of Chromyl Chloride." 9. Messrs. A. T. de Noulpied and A. Rule, "Tetraketopiperazine."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. C. Harrison Townsend, "The Art of Pictorial Mosaic."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. W. N. Shaw, "Recent Advances in the Exploration of the Atmosphere." (Lecture I.)

Historical, Clifford's-inn Hall, Fleet-street, E.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, JAN. 18...Royal Institution, Albemarle-street, W., 9 p.m. Sir Andrew Noble, "Fifty Years of Explosives."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m, Paper on "Stencilling."

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Adjourned discussion on "Lighting of Railway Premises: Indoor and Outdoor." 2. Pro- ds, fessor H. C. H. Carpenter and Mr. C. A. Edwar ttee: Eighth Report to the Alloys Research Commi on and "The Properties of the Alloys of Aluminiu C Copper." and eet, W.,

SATURDAY, JAN. 19..Royal Institute, Albemarle-st ort oe Lates 3 p.m. Sir Alexander Mackenzie, "Th Unite Phases of Music." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, JANUARY 23, 8 p.m. (Ordinary Meeting.) PHILLIPPE BUNAU-VARILLA, "The Panama Canal—The 'Lock Canal' type and the 'Straits of Panama' type."

THURSDAY, JANUARY 24, 4.30 p.m. CAPTAIN E. BARNES, "The Bhils of Western India."

Further details of the Society's meetings will be found at the end of this number.

COLONIAL SECTION.

Tuesday afternoon, January 15; COLONEL SIR FREDERICK D. LUGARD, K.C.M.G., C.B., in the chair. The paper read was "The Progress of the Uganda Protectorate," by GEORGE WILSON, C.B., Deputy-Commissioner Uganda Protectorate.

The paper and report of the discussion will be published in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ARTIFICIAL FERTILISERS: THEIR NATURE AND FUNCTION.

BY A. D. HALL, M.A.,
Director of the Rothamsted Experimental Station, Lawes Agricultural Trust.

Lecture IV.—Delivered December 10th, 1906.

Before passing on to the phosphatic manures, it is necessary to consider how far each of the three substances—nitrogen, phosphoric acid, and potash—possesses a specific effect that shows itself in the plant whenever there is either an excess or defect of the particular constituent in the soil. To answer this question properly, we should require to know what is the physiological function of each of these constituents of the plant's food, and though we are still far from any fullness of knowledge, certain general conclusions may be drawn both from field experiments and from the experience of the farm. In the first place, nitrogen is mainly concerned with the vegetative growth of the plant, with the formation of leaf and stem which are the necessary preliminaries to complete development. A deficiency of nitrogen results in a stunted general growth, in which the grain or seed bears a high proportion to the whole weight of the crop; the plant on analysis, however, shows no marked lack of nitrogen as compared with the other constituents. These other bodies, phosphoric acid, potash, &c., in whatever excess they may be present in the soil, are only taken up by the plant as it can use them, *i.e.*, in quantities proportionate to the growth, which in its turn is proportionate to the nitrogen supply. As the amount of available nitrogen is increased the development of leaf and shoot increases, their green colour deepens, and maturity tends to become more and more deferred, so that a crop grown on land over-rich in nitrogen, always tends to be late and badly ripened and to show a profusion of leaf, characters which, in the case of a grain crop, often result in lodging before harvest.

But the fact that the primary growth of the plant is up to certain limits almost proportional to the supply of nitrogen, so that an application of nitrogenous manure has a quickly visible effect, not only makes it the leading constituent of a fertiliser, but is apt to give it a fictitious importance in the farmer's eyes. The following Table shows how with increasing nitrogen it is the straw that benefits more than the grain :—

TABLE XIX.—INCREASE PER CENT. FOR EACH ADDITION OF NITROGEN.

	Wheat Grain.	Wheat Straw.
43 lb. N.	56·3	63·3
86 ,, ,, ...	46·4	66·3
129 ,, ,, ...	10·4	28·0
172 ,, ,, ...	2·7	23·5

As the nitrogen comes to be in excess, various secondary effects manifest themselves, chiefly due to over-development of the vegetative parts of the plant. Flowers tend to double and proliferate, organs like the pales and glumes of barley grow extra stout, and the grain assumes a coarse appearance; at the same time the tissues of the plant are soft and weak, so that it easily falls a prey to fungoid attacks. This latter effect is very palpable on the Rothamsted mangel plots, some of which receive relatively an excessively high amount of nitrogenous manure. On these plots, and only on them, there annually occurs a leaf-spot disease—*Uromyces betae*—which towards the end of the season almost wholly destroys the leaves of the mangels on the high nitrogen plots, whereas it is not to be seen elsewhere. It has been ascertained that the epidermis and other tissues of the leaf are actually thinner in the cell wall when they have been grown with an excess of nitrogen, but this is probably not the main cause of the incidence of the fungoid disease, which is more likely to be due to the formation of a cell-sap more congenial to the fungus. Similarly, among cereals like wheat rust is always most prevalent on the plots receiving the greatest amounts of nitrogen, or again in seasons or climates giving rise to an exceptionally high temperature of the soil in early spring, so that there is for a time an over-rapid production of nitrates for the plant. For example, in countries where a rainless or a too severe winter compels the sowing of spring wheat late in the season, followed by high temperatures with plenty of moisture, the first growth is extremely rapid, and rust is always very prevalent; over the greater part of South Africa wheat and barley cannot be grown for this reason.

Just as nitrogen delays maturity by promoting growth, phosphoric acid has an opposite effect; it is in some way closely bound up with grain formation, being always found in greater proportions in the reproductive parts of the plant than elsewhere. This ripening action is very clearly seen in the Rothamsted experiments on barley; the plots without phosphoric acid being as a rule about a week behind those which receive this fertiliser. Naturally, such an effect of phosphoric acid is particularly seen in a wet year when the crop is late to harvest. The following Table will illustrate the point: it gives the yield and other particulars of one series of the Rothamsted barley plots in 1893, a specially dry season, and in 1894 which was almost equally wet.

TABLE XX.

	Grain, bushels.		Grains to 100 Straw.		N Per Cent. in Grain.	
	1893.	1894.	1893.	1894.	1893.	1894.
Ammonium salts alone	11·6	10·4	85·3	67·5	2·19	1·65
Ammonium salts and superphosphate	18·1	34·9	101·0	77·0	2·13	1·60
Ammonium salts and potash	16·8	17·8	85·9	73·8	2·17	1·61
Ammonium salts, super, and potash..	30·8	41·4	102·2	77·7	2·08	1·44

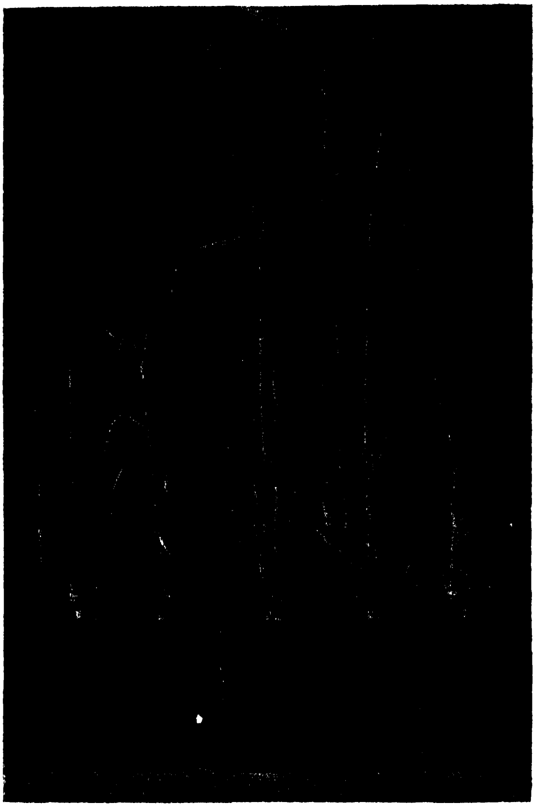
The phosphoric acid increases the proportion of grain to straw, and decreases the nitrogen content of the grain, and it will be noticed that this latter effect is more marked in the wet season of 1894. Even in the yield itself the phosphoric acid had the greater effect in the wet season.

The action of phosphoric acid on the plant is not confined to its ripening effect; it stimulates the early development of the young seedling to a remarkable extent. Farmers are well acquainted with the good start that any crop gets when manured with superphosphate; indeed it is often used merely to secure a better plant, though with little expectation of otherwise increasing the yield. More than sixty years ago this had been noticed by the late Sir John Lawes; and in one of his earliest papers on "Turnip Culture," in 1847, he writes: "Whether or not superphosphate of lime owes much of its effect to its chemical actions in the soil, it is certainly true that it causes a much enhanced development of the underground collective appa-

ratus of the plant, especially of lateral and fibrous root."

In this statement he was vigorously attacked by Liebig, but some experiments, which are still in progress, show that it was the result of sound observation, and that in some way or other phosphoric acid does stimulate the root development of the young plant. The photograph (Fig. 2) shows a series of water cultures of barley growing in solutions which are alike as far as regards the nitrogen, potash magnesia, lime, &c., but which differ as regards phosphoric acid, being respectively 0, 1-20,000th, 1-8,000th, 1-2,000th, and 1-1,000th normal solutions of that constituent. The root development, which is practically nil in the absence of phosphoric acid, increases with each addition up to about 1-2,000th normal strength. Similar water cultures, in which nitrogen or potash is omitted (see Fig. 1, p. 135), while they show equally feeble development of the plant as a whole, yet give rise to a comparatively extensive root development.

FIG. 2.



1 2 3 4 5

EFFECT OF PHOSPHORIC ACID UPON ROOT DEVELOPMENT OF BARLEY IN WATER CULTURES.

1. Solution contains no Phosphoric Acid.
2. ,, = 1-20,000 normal Phosphoric Acid.
3. ,, = 1-8,000 ,, ,, ,,
4. ,, = 1-2,000 ,, ,, ,,
5. ,, = 1-1,000 ,, ,, ,,

Other constituents of the solution alike in all cases.

To what extent this stimulus to root growth is brought about by other sources of phosphoric acid and under diverse conditions of soil, has not yet been worked out, but there can be little doubt but that it explains why a phos-

phatic manuring has such a valuable effect in establishing the plant, even if the gross yield is not ultimately much enhanced.

It may also go to explain the extraordinary results of quite small dressings of phosphoric acid upon soils in Southern Australia, where a manuring with half a hundred-weight per acre or even less of superphosphate has been found sometimes to double the yield of cereals. On analysis the soils are not rich, but they show no such signal deficiency in phosphoric acid as would account for the action of the manure; it seems much more likely that in a semi-arid country where the whole success of the crop depends on the roots getting quickly down to the cooler and moister subsoil, the stimulating action of the phosphoric acid upon the young roots becomes of the greatest value. In this connection it may be noted that tne two crops which most respond to phosphatic manuring, turnips and barley, are both possessed of shallow roots, confined to a comparatively limited layer of soil; whereas, under ordinary farming conditions, wheat responds very little to phosphoric acid, and mangels hardly at all, both being deep-rooted plants.

It has sometimes been surmised that phosphoric acid is associated with the assimilation of nitrogen by the plant, and particularly with its migration from the stem or roots into the seed, the opinion being probably founded on the fact that the nucleo-proteids, so characteristic of the reproductive parts of plants, contain phosphorus. This opinion is not, however, borne out by the examination of a large number of analyses of barley grain from the Rothamsted plots; when phosphoric acid is deficient, the intake of nitrogen is not proportionally reduced; in fact, the grain grown on the plots not receiving phosphoric acid, is the richest in nitrogen.

The phosphatic manures are practically all compounds of phosphoric acid with lime, and, as is well known, four distinct combinations exist and are found in commerce. Only one, the di-hydrogen calcium phosphate, the characteristic constituent of superphosphate, is to any degree soluble in water; the others give rise to extremely dilute solutions of phosphoric acid, too dilute, as has been shown by experiment, to nourish a plant properly with however large a volume of the solution it may be in contact. Yet insoluble as di, tri, and tetra basic phosphate of lime are, when they are sufficiently finely divided, and well incorporated with the soil so as to be in contact with the roots, they are all effective in supplying the plant with phosphoric acid. An experiment of Kossowitsch's illustrates this point. He had prepared two pots of sand, with which a certain amount of insoluble phosphate was incorporated, and a third pot containing sand alone. In one of the pots containing phosphate certain plants were sown, which were also introduced into the pot of pure sand. But while the former pot was watered with pure water, the latter pot of sand was kept fed with a continuous trickle of water that had flowed through the second sand and phosphate pot without vegetation. Thus, in one case, the roots of the plant were in contact with the ground phosphate, in the other only with the solution arising from it. Of course, both sets of plants were equally furnished with nitrogen, potash, &c., but it was found that only those whose roots were in the same pot with the phosphate made a satisfactory growth; in the other pot the plants were phosphoric acid starved.

This experiment shows that the roots themselves do something towards the solution of the insoluble phosphates, a fact also seen in Czapek's extension of Sachs' original experiment, in which a slab of smooth phosphate placed in contact with the roots of a growing plant, is found after a time to be covered with etched figures of the roots. The view, however, that the solution is effected by the excretion of the acid sap, known to be contained in the roots, is not supported by any evidence demonstrating that such acid can ever get outside the root and into contact with the particles of phosphate; it is the carbon dioxide which the roots are always excreting that brings about the solution of the phosphate. At the point it leaves the root it momentarily forms a concentrated solution possessed of considerable solvent power for phosphates and carbonates.

Since only one of the commercial phosphates is freely soluble in water, yet all of them have to enter into solution before they can be utilised by the plant, the question of their relative availability is not easy to settle, and a variety of solvents have been proposed for its determination in the laboratory. In Germany, for example, basic slag is usually valued, not on the total amount of phosphoric acid it contains, but on the amount that is soluble in a strong ammoniacal solution of ammonium citrate, the idea being that this re-agent discriminates between the tri-calcium phosphate, which is insoluble, and the di and tetra calcium phosphates, which will dissolve

in the medium. Instead of the ammonium citrate, 2 per cent., 1 per cent., and 0·1 per cent. solutions of citric acid have been proposed, and are used by various chemists in valuing phosphatic fertilisers. None of these solvents, however, really discriminate between the different phosphates, all of which are soluble up to a certain point, when an equilibrium is established between the phosphoric acid in solution and that remaining undissolved. If the first solution formed is replaced by a fresh portion of the solvent, more phosphoric acid will come into solution; in fact, all the phosphates are eventually completely dissolved by the solvents in question. The following Table shows the amount of phosphoric acid extracted by a 1 per cent. solution of citric acid from one of the Broadbalk soils manured for fifty years with superphosphate, the extraction being repeated with fresh solvent as soon as one portion had been saturated and then removed:—

100 GRAMS BROADBALK SOIL (PLOT 7) WITH 1 LITRE 1 PER CENT. SOLUTION OF CITRIC ACID.

1st Extraction	56·1	mgms.	P_2O_5	dissolved
2nd ,,	22·8	,,		,,
3rd ,,	8·9	,,		,,
4th ,,	6·5	,,		,,
5th ,,	4·4	,,		,,
6th ,,	4·4	,,		,,

Very similar results have been obtained when manures are treated in the same manner, and they may be taken to show that a single extraction of any solvent of the kind proposed will not dissolve the whole of a particular compound of phosphoric acid, which may be thereby distinguished from the rest of the phosphates left unattacked. Such a mode of attack should be regarded as affording only empirical figures to assist the analyst in forming a judgment of the manure; and the conditions of making the solution, such as time, shaking, relative amounts of solvent and substance, must be strictly defined. Furthermore the only solvent which has any *à priori* justification is a solution of carbon dioxide which does the work in the soil; the acids of the cell sap, to resemble which citric acid was taken, have been shown to have no direct contact with the soil particles.

Among the phosphates that are employed as manures, the senior position must be given to bones, the fertilising properties of which have been known from time immemorial. In the eighteenth century we find that their use was an integral part of "Hertfordshire Husbandry," then perhaps the most advanced farming in the country, and but a little later the Cheshire farmers were beginning to build up the richness of their famous milk pastures by the constant use of the same material. So great was the demand that England soon became an importer of bones, taking in 1822, long before the need for phosphoric acid in the nutrition of the plant had been established, as much as 33,000 tons from Germany alone. Forty years later Liebig was moved to one of his characteristic outbursts on this very point. "England is robbing all other countries of the conditions of their fertility. Already in her eagerness for bones, she has turned up the battlefields of Leipsic, and Waterloo, and of the Crimea; already from the catacombs of Sicily she has carried away the skeletons of many successive generations. Annually she removes from the shores of other countries to her own the manurial equivalent of three million and a-half of men, whom she takes from us the means of supporting and squanders down her sewers to the sea. Like a vampire she hangs upon the neck of Europe, nay, of the whole world, and sucks the heart blood from nations without a thought of justice towards them, without a shadow of lasting advantage for herself"! Well Germany is paying herself back now by taking our sulphate of ammonia and our basic slag.

Though no longer the unique source of phosphoric acid, bones are still a very important element in the fertiliser trade; last year we imported 47,346 tons, the home production being rather greater. In the main these bones get sold in three forms; after treatment with acid; in the raw, ground-up condition, only the fat having been removed, as bone meal; and thirdly, after they have been degelatinised and the greater part of the nitrogen removed, as steamed bone flour. Raw bones or bone meal, though the price has been at a low level for some years, still seem to be rated too highly; the nitrogen of the phosphoric acid they contain being over-valued if we take into account their availability as shown by field experiments. Practically, all the experiments go to show that bone meal is so slow in its action that quite excessive amounts have to be used and locked up in the soil, if any immediately appreciable result is to be obtained.

Nor is the reason far to seek; owing to the toughness of the ossein structure of the bone it is a matter of difficulty to reduce it to a

really fine state of division, at any rate the bone meal of commerce is a comparatively coarse powder. Now it has already been pointed out that a tricalcic phosphate, such as exists in bones, is very far from insoluble in water charged with carbon dioxide, but, as with all sparingly soluble salts, the rate of solution will be proportional, other things being equal, to the amount of surface the solid exposes to attack, and for a given weight of material this increases in the same proportion as the average diameter of the particles decreases. In consequence, for all the insoluble phosphatic manures fineness of grinding is perhaps the most important factor, upon it more than even upon the chemical composition depends the availability of the fertiliser to the plant. Bone meal is slow-acting and ineffective because it is coarse, nor is the valuable phosphoric acid brought into solution more readily in the second year than in the first, because the coarse condition still persists. The availability of a phosphatic fertiliser might even be reckoned as the product of two factors, a solubility factor depending upon its chemical composition, and a second factor—the area of surface of unit weight of the material.

If bone meal has been overrated, on the other hand steamed bone flour has not received the credit it deserves. In the first place analysts have rather warned the farmer against steamed bone flour, as representing in some way a spurious bone meal from which the nitrogen had been illicitly extracted. The warning is needful enough if the steamed bone flour were in any way being passed off as bone meal, but provided it is sold on its own basis as a material containing nearly sixty per cent. of tri-calcic phosphate and one per cent. or so of nitrogen, it is a better manure than bone meal. The fine grinding allows the phosphates to pass into solution, and the ossein of raw bones, in which their nitrogen is present, decays so slowly that it becomes one of the most ineffective of fertilisers.

The next phosphatic deposit to receive much attention was guano, which has already been mentioned as a nitrogenous manure. Properly speaking the term guano should be restricted to material, consisting almost wholly of the excreta of sea birds, which has accumulated upon certain oceanic islands in the more rainless districts of the earth, where the birds habitually nest in vast numbers. The best known and richest of these deposits occur off the coast of Peru between the 7th and 20th parallels of south latitude, but similar deposits have been found upon islands on the west coast of South Africa (Ichaboe and Damara Land), the Pacific (Baker, Abrohlos, Christmas and Ocean Islands), Bolivia (Mejillones), the West Indies (Aruba, Navassa, Sombrero), and many other places. The original deposit is mainly a nitrogenous compound, and as may be seen from the analysis previously given of Chinchas guano (a deposit known to have accumulated within the last forty years) it may contain as much as 18 per cent. of nitrogen and only 9 per cent. of phosphoric acid. The action of the weather, particularly where the climate is not absolutely rainless, is always removing the nitrogenous compounds, so that the proportion of phosphoric acid tends to increase, until even among the Peruvian deposits a guano is found on Lobos Island containing little more than 2 per cent. of nitrogen and 60 per cent. of phosphate of lime. In some of the other deposits that have been enumerated, Christmas Island, for example, the nitrogen has entirely disappeared and a phosphate rock is left behind, which can only be termed a guano in virtue of its origin. These purely phosphatic deposits, many of which are now exhausted or no longer pay to work, have been so much mineralised that they are not sold as guanos but are employed for the manufacture of superphosphate. However, the Lobos phosphatic guano is still extensively imported, and being naturally soft and in a fine state of division, it can be applied without treatment to the land, and forms one of the most valuable of the neutral phosphates that are so well adapted to light soils. With the exception of the Peruvian deposits and those from the Pacific, Christmas, and Ocean Islands, practically none of the other deposits are now worked.

In 1845, when the use of phosphatic manures was beginning to arouse general attention, Professor George Henslow called the attention of agriculturists and manure makers to the coprolites which occur over a considerable area of the eastern counties as a bed about a foot thick at the top of the lower greensand formation or at the bottom of the gault. These coprolites, which take the form of pebbles containing 50-60 per cent. of calcium phosphate and 20 per cent. or so of calcium carbonate, consist of concretions of phosphate of lime deposited round excreta, fragments of bone and shell, shark's teeth, &c., and were for many years mined in Bedfordshire, Cambridge, Suffolk, &c.; the output being as much as 50,000 tons per annum in 1884, though now it

has entirely ceased owing to the competition of the richer deposits which have become available. Similar deposits were worked in France, Belgium, and Germany, generally in rocks of cretaceous age, but they attain their greatest development in Florida, Tennessee, and South Carolina. There in many places the subsoil is a sandy deposit full of coprolitic pebbles, which can readily be separated by screens or washing; the beds of the rivers and creeks, again, are wholly composed of the same pebbles which are recovered by dredging. The river deposits have been particularly valued in Great Britain for superphosphate making, because though they only contained about 60 per cent. of phosphate of lime they were particularly free from iron and alumina. About 150,000 tons per annum used to be imported, but of late years the supply has been falling off. The various phosphate deposits in North America yielded in 1901 nearly 1,600,000 tons, of which more than half was exported to Europe.

Just as it is impossible to draw a line between the recently formed true guanos and the weathered deposits which have practically become phosphate rock, so again no real distinction can be made between the guanos and coprolites of known origin and the phosphate-bearing strata, which are to be found in many countries, and at all geological horizons. Many of these may have originated in guano beds, others are coprolitic, others again are due to solution of phosphate of lime, originally diffused through a great mass of rock, and its concentration in a single layer. In all cases, however, the material has been of animal origin, whatever processes of solution and redeposition it may have suffered since. In the older rocks the phosphate has often become crystalline, forming the hard mineral known as apatite and mined on a small scale in Canada and Norway. The Estramadura deposits were perhaps the first of the rock phosphates to be described, though they were not much worked until the seventies of the last century. Lahn phosphates from Germany, and the Somme phosphates from the north of France were the most largely exported of these rock deposits, until the first of them was wholly and the latter partially displaced by the discovery of richer American deposits. However, these are now in their turn yielding to the competition of the great deposits of phosphate rock which have been discovered in Northern Africa, and which are now being exported in immense quantities from Algeria and Tunis. The phosphate bed appears to stretch right across the continent, but Morocco has, naturally, not been explored, while the Egyptian rocks as yet examined are hardly rich enough in phosphoric acid for export, though immense beds exist containing 40 to 50 per cent. of tricalcium phosphate. The most important of the phosphate mines in North Africa occur in the province of Constantine in the district of Tebessa, from whence they extend into Tunis, near Gafsa. The rock is generally at the base of the eocene system, and occurs in strata that may be 2½ or 3 metres thick and contain as much as 60 per cent. of calcium phosphate, which may be raised to 70 per cent. by picking over. These African phosphates contain but little iron and alumina, and are rapidly becoming the chief material for the manufacture of superphosphate in this country.

The mineral phosphates have been but little employed directly as manures, though there is plenty of evidence that when they are really finely ground they are effective enough on soils retaining plenty of water, and particularly on those of a peaty nature. Recent German experiments also indicate that such ground mineral phosphates are most available when mixed with ammonium sulphate, which, as already explained, acts as a physiologically acid manure and helps to bring the phosphoric acid into solution. In the main, however, the mineral phosphates are used in the manufacture of superphosphate, practically the only manure containing phosphoric acid at all readily soluble in water.

The first published reference to the use of sulphuric acid to produce a soluble phosphate appears to be in Liebig's Report to the British Association in 1840, in which he recommends that bones should be so treated. However, there is very little doubt that various people in this country had previously made what we now call dissolved bones for agricultural purposes; indeed, in the same year, 1840, Lawes was trying a superphosphate made from bone ash on a comparatively large scale on his own farm. Lawes's private experiments began in 1837, and during the next year he was asked if he could not turn spent animal charcoal, bone char, or bone ash, of which large quantities were available as a waste product in London, into something useful as a manure. He tried it in his plot experiments, and found its efficacy much increased by treatment with sulphuric acid; by 1840 his plot experiments had been exchanged for large scale trials in the field. Lawes took out his first patent for treating mineral phosphates with acid in 1842:—
"Phosphatic substances have heretofore been

employed as manure, but always, to the best of my knowledge, in a chemically undecomposed state, whereby the action on the soils to which they have been applied has been tardy and imperfect. It is in particular well known that in the case of a large proportion of the soils of this country the application of bone dust is of no utility in producing crops of turnips on account of the slow decomposition of bone dust in the soil and the consequent exposure of the young plant for a long time to the ravages of the turnip fly." Lawes found it necessary to disclaim the application of acid to bones in his patent, confining it to "phosphatic substances, apatite, or phosphorite," and it was on this basis his manufactures began. Since also Liebig, in his many controversies with Lawes, never claimed against him any priority in the use of sulphuric acid to dissolve phosphates, it may be concluded that prior to 1840 the use of acid to attack bones was common knowledge, and that Lawes's application of it to mineral substances was his own idea and not derived from Liebig.

At first bone ash and bone char were the phosphatic materials used in the manufacture of superphosphate, then followed the discovery of coprolites, developed in the eastern counties by Packard, after which the various foreign phosphates already enumerated followed in rapid succession. In the manufacture of super a rich phosphate of lime is desirable, containing for the high grade supers at least 70 per cent. of tri-calcium phosphate, with as little oxides of iron and aluminium as possible and a few per cents. of calcium carbonate. The latter, though it wastes sulphuric acid by giving rise to an excess of gypsum, results in a dryer and more friable super that can be readily handled in the drill.

The phosphates of alumina and iron are undesirable because they give rise to sulphates of these metals and free phosphoric acid, which, however, slowly change back into the original substances on storage of the manure. Hence the proportion of phosphoric acid soluble in water immediately after manufacture declines, and in its place are found precipitated phosphates known as retrograde or reverted phosphate, which are not taken into account in the British method of estimating superphosphates by the water soluble phosphoric acid only. The exact value of these phosphates is a matter on which opinions are divided, but at the present time the question is less pressing, because of the abundance of raw material practically free from iron and aluminium. When superphosphate is applied to the soil the soluble phosphoric acid it contains is rapidly reprecipitated; to some extent the clay provides the necessary base, but on most soils the calcium carbonate takes the chief part in the reaction, with the production of the di-calcium hydrogen phosphate. As this precipitation takes place all throughout the soil the phosphate is very finely divided and thoroughly disseminated, hence the great effectiveness of superphosphate. How thorough the precipitation of the phosphoric acid is within the soil may be seen from Dr. Bernard Dyer's examination of the soils from the Broadbalk wheat field which had been receiving $3\frac{1}{2}$ cwt. per acre of high grade super for 50 years previously. He found that though the surface soil to the depth of nine inches had been enormously enriched in phosphoric acid soluble in 1 per cent. solution of citric acid, the subsoil below had practically gained none, so complete had the precipitation been in the layer stirred by the plough. Again, the drainage waters from these plots show a most trifling amount of phosphoric acid, so that losses by washing out must be negligible. Still more cogent evidence of the retention of phosphoric acid by the soil has been obtained more recently by applying the method of successive extractions with a 1 per cent. solution of citric acid until the phosphoric acid going into solution has fallen to the low constant figure indicating the solubility, not of the recently added, but of the original soil phosphates. About five extractions remove the

TABLE XXI.—Phosphoric Acid Soluble in five extractions with 1 per cent. Citric Acid compared with that in Manure and Crop. (Rothamsted, 1904.)

	Phosphoric Acid, lb. per acre.			
	Supplied in Manure.	Removed in Crop.	Surplus in Soil.	Dissolved by 1 per cent. Citric Acid.
Broadbalk, Plot 3	–	550	−550	565
" " 5	3,960	790	3,170	3,000
" " 7	3,810	1,370	2,440	2,470
" " 8	3,810	1,520	2,290	2,055
Hoos, Plot 1	0	555	−555	400
" " 2	3,390	1,200	2,190	2,315
" " 4	3,390	1,240	2,150	2,000

phosphoric acid down to this point; further extractions removing very little more, and the sum of the phosphoric acid dissolved in these five extractions approximates very closely to the surplus of phosphoric acid supplied as superphosphate over that removed in the crop.

This shows that phosphoric acid supplied as superphosphate remains in the surface soil, and in a form that is readily soluble in weak acids such as a dilute solution of citric acid or the natural solution of carbon dioxide occurring in the soil. Doubtless the result would be modified if the soil were not well provided with calcium carbonate, in which case more insoluble phosphates of iron and alumina would be formed. It is a fair conclusion to draw from these results that super, and indeed, all phosphatic manures, may be applied to the land much earlier than is usually the case; because there is not the least fear of their washing out, and it is all important to get them well disseminated through the soil by solution and reprecipitation and by cultivation. For the turnip crop there may perhaps be some advantage in drilling the manure with the seed, so important is it to have the young roots stimulated by an abundance of phosphoric acid close at hand, but with other crops much of the benefit of phosphatic manures is often lost because they are applied when the land has already begun to run short of water. Fine grinding and early application are the two great factors in making phosphatic manures available.

There remain for consideration two other phosphatic manures which form a class apart, in that their reaction is alkaline instead of being acid or neutral as in the cases already dealt with. One of these manures, "basic superphosphate," is manufactured by neutralising superphosphate with enough caustic lime to precipitate the soluble phosphate as dicalcic phosphate or retrograde phosphate and also to leave a small excess of free lime in the mixture. It is recommended for the lighter soils lacking in calcium carbonate and in consequence unsuited to superphosphate. These soils are also, as a rule, too dry for basic slag. Basic superphosphate has not as yet been put to any systematic test against other sources of phosphoric acid; its fineness of division should, however, do much to make it effective.

In the other alkaline phosphatic manure, "basic slag," the phosphoric acid is supposed to be present as a tetra-calcium compound, which, however, is readily attacked by acids as weak as the solution of carbonic acid in the soil, it is thereby split up into dicalcium phosphate and calcium carbonate, so that in such media it becomes more soluble than tricalcium phosphate. In the basic slag of commerce there is always some phosphorus present as phosphides rather than phosphates, and how far these compounds ever become available for the plant has never been investigated. There is also always in basic slag an excess of lime over that which is combined with the phosphoric acid, silica, &c., but there appears to be little definite information about the amount that is left free in this way. Considering the importance of the basicity of the manure, it is rather curious that so little attention is paid to this point in the ordinary analyses for commercial purposes.

The story of the manufacture of basic slag and of the discovery of its fertilising properties when merely finely ground has been told so often, and is so much a matter of recent history that there is no need for me to repeat it, but introduced into the fertiliser trade so recently as 1886, at the present time about 300,000 tons are manufactured annually, of which 120,000 are exported.

The immense success of basic slag has in this country been mainly due to its special power of improving a particular class of poor grasslands on clay. The soils of these clays are naturally lacking in both phosphoric acid and carbonate of lime, and when they have been long down to grass they become covered with a thin poor herbage of "bent" grass (*Agrostis*), which creeps along the surface in straggling tufts and affords very poor grazing for any kind of stock. Farmyard manure and almost any form of nitrogenous fertiliser have no good effects, often an injurious one, but the summer following a dressing of basic slag the whole pasture becomes covered with white clover, small plants of which had previously been living stunted beneath the bents. Stock now graze the land with great relish, and the vegetation year by year improves, the *agrostis* giving place to clovers and other grasses of better character. One of the great factors in this change is the lime in the basic slag. It renders available some of the reserves of potash and nitrogen in the soil, and of the latter there is a great accumulation in any old pasture. Both by its alkaline reaction, its liberation of potash, and the aeration it induces by flocculating the clay when some of the lime is washed into the soil as calcium

bicarbonate, it aids the phosphoric acid to render the soil favourable for the growth of leguminous plants, hence the sudden appearance of the hitherto dormant white clover. The white clover is always closely grazed, and as it collects nitrogen from the atmosphere, the whole herbage on the land, grasses as well as clovers, is improved year by year.

On some soils it is well-known that basic slag has no visible effect, there is neither the general improvement in the growth of the grass, nor the sudden appearance of white clover which leads to the permanent enrichment. There are three factors which may be operative in bringing about this comparative uselessness of basic slag. In the first place on some soils the dormant plants of white clover do not exist or are present in such small numbers as to be inappreciable in the first year or two following the application of the manure. As Professor Middleton has shown, it is necessary in these cases to follow up the application of basic slag with a seeding of white clover, harrowed into the land.

Secondly, on sandy soils, with little clay in their composition, there is no reserve of potash compounds to be rendered available by the lime of the basic slag; the Rothamsted experiments show very clearly that it is potash which pushes on the clovers in grass land, and that phosphates do very little for them in the absence of lime, hence when basic slag can act only as a phosphatic manure it will benefit the leguminous crops but little. In such a case potash manures must be used with the basic slag. Lastly, the visible effects of basic slag are always smaller on land newly laid down, simply because there is not the accumulation of nitrogenous material from past crops which characterises old grass land. The lime in the basic slag renders some of this reserve material available for the herbage, the increased supply of nitrogen being apparent in the fuller green the grass assumes.

It should not be supposed, however, that in any of these cases the basic slag is without value because its application is not visible; phosphatic manures never have the effect upon the growth and colour of the crop which nitrogenous manures have, so that they can only be properly judged by the weight and quality of the crop at harvest time.

The question is often raised of how far the improvement effected on grass land by basic slag is permanent and likely to be repeated if the treatment is continued. Only one constituent of a crop is being supplied, the phosphoric acid, whereas potash and nitrogen also are being taken away, having been obtained from the soil through the action of the lime in the slag. When the land is being grazed, however, nearly all the potash and a large proportion of the nitrogen in the grass are returned to the soil in the excreta of the animal; at the same time the clovers are drawing nitrogen from the atmosphere, so that there is no practical loss of fertility. At any rate, feeding out a little cake, which is justified by the improvement in the feeding qualities of the pasture, will more than compensate for any withdrawal of nitrogen. When the land is hayed the case is different, because there is a much greater removal of nitrogen and especially of potash. The Rothamsted experiments show that when only phosphates and potash are supplied to grass land, though the leguminous plants become the characteristic features of the herbage, they cannot collect nitrogen fast enough to furnish a large crop of hay year after year, hence a profitable hay crop cannot be grown continuously without some external supply of nitrogenous fertiliser. When potash also is withheld the land soon becomes impoverished; with phosphates alone the effect is good at first, but in the end the land becomes poorer than if no manure at all had been supplied, because the draft on the potash and nitrogen originally present in the soil has been increased. Hence, after the first few years, when the reserves of potash in the soil set free by the lime of the basic slag have been somewhat reduced, potash manures will be required. Under more ordinary conditions of farming when the land is sometimes grazed and sometimes hayed, it may be said that after the first four years or so of great improvement of the land by basic slag, then cake feeding, and perhaps a little nitrate of soda for the hay crop is necessary to keep up the nitrogen supply, and that subsequent applications of basic slag should be accompanied by some potash manure.

SIXTH ORDINARY MEETING.

Wednesday, January 16, 1907; Sir WILLIAM PREECE, K.C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Amsberg, Simeon Ernest, Penang, Straits Settlements.

Bose, Asok, University, Birmingham.

Braithwaite, James E., 6, South-parade, Leeds.
Burt, Andrew, M.I.M.E., M.Am.I.M.E., Fleets-house, Tranent, N.B.
Buyzer, Charles Allan Oswald, F.S.I., 128, Hultsdorp-street, Colombo, Ceylon.
Campbell, William Archibald, 144, Warren-avenue, Chicago, Illinois, U.S.A.
Chaussé, Alcide, 1051, St. Hubert-street, Montreal, Canada.
Dadachanji, Rustonshaw K., B.A., LL.B., Kalbadevie-road, Bombay, India.
Edwardes, Stephen M., Highfield, The Ridge, Malabar Hill, Bombay, India.
Emslie, B. Leslie, Dominion Agricultural Offices of the Potash Syndicate, 3, Holbrook Chambers; 104, Sparks-street, Ottawa, Ontario, Canada.
Hogg, John, 13, Paternoster-row, E C.
Humphries, Albert Edward, Balfour-road, Weybridge.
Johnston, John, B.A., The Villiers Endowed School, Limerick.
Kamm, Director, The Rigibahn, Goldau-by-Zurich, Switzerland.
Khan, Ahmad Hosain, B.A., Sessions Court, Jhelum, India.
Law, J. A., Birkbeck Bank-chambers, Chancery-lane, W.C.
Middleton, Professor Thomas Hudson, M.A., Board of Agriculture and Fisheries, 4, Whitehall-place, S.W. and University, Cambridge.
Pennant, Claude Douglas, 2, Mitre-court-buildings, E.C.
Rowntree, Bernard, 20, Queen-square, W.C.
Schenck, F. E. E., Studio, 1A, West-street, Pimlico, S.W.
Seaton, Mrs. Ellen Jeannette, 93, St. George's-square, S.W.
Tatsuno, Professor Kingo, M.E., Imperial University, Tokyo, Japan.
Tyler, William Ferdinand, Royal Societies Club, St. James's-street, S.W.
Wilson, Fred., 24, Palace-gardens, Enfield, N.

The following candidates were ballotted for and duly elected members of the Society:—

Bainsmith, Mrs. Georgina Fairholme, St. Ives, Cornwall.
Cuthbertson, Ebenezer, 33, Arncliffe-gardens, West Hartlepool.
Flurscheim, A., Chancery-lane Station-chambers, 31, High Holborn, W.C.
Habell, Frank Stannah, care of Messrs. W. Hill and Co., Elderslie Rock Blasting, Renfew, near Glasgow.
Higgins, Eric, 5, Oak-terrace, Fairfield, Liverpool.
Honey, Richard, 2a Providencia, Mexico City, Mexico.
Honey, Thomas P., 2a Providencia, Mexico City, Mexico.
Ibbs, Miss Edith A., 3, Endsleigh-gardens, N.W.
Keen, Walter Henry, Portland-lodge, Atkins-road, Clapham-park, S.W.
Raegener, Louis C., 141, Broadway, New York City, New York, U.S.A.
Roberts, James, 1, Paper-buildings, Temple, E.C.
Shafi, S. M., 54, Poonamallee High road, Parktown Post, Madras, India.
Street, Arthur William, 37, Hamilton-square, Birkenhead, Cheshire.
Thompson, Charles, 11, Norfolk-street, Strand, W.C.
Wilson, George, C.B., Hans-crescent Hotel, Hans-crescent, S.W.

The discussion on Mr. J. W. GORDON'S paper on

"PATENT-LAW REFORM,"

was resumed—

Sir LLOYD WISE, in resuming the discussion, said the subject of the measures to be adopted under the Patent-law for adequately protecting English manufacturing industries without unfairly handicapping the inventor was by no means a new one. It had been discussed over and over again within the last thirty or forty years, and he was very glad that the author by his able paper had afforded an opportunity for discussing it in the light of later experience at the Society of Arts, where so many fruitful discussions on Patent - law reform had taken place. The author realised that in certain cases at the present time the Patent-laws operated in a manner which might be oppressive to certain manufacturing industries. One of the remedies suggested was a reconsideration of the practice with regard to the granting of injunctions. He could not presume to place his experience on such a point against that of so able a lawyer as Mr. Gordon, but so far as his experience had gone he had not found that Courts were excessively ready to grant injunctions; at any rate, they would not usually grant an injunction until the case had been tried, and it had been proved to their satisfaction that there was a sound patent, and it had been infringed. Opinions might differ, he admitted, as to whether a patent was sound or had been infringed, but they had to bow ultimately to the tribunal whatever the decision might be. According to his experience, the Courts were not in the habit of granting injunctions until they had satisfied themselves, and the author had not succeeded in persuading him that it would be desirable to abolish the practice of granting injunctions. The objection taken to the present state of affairs was that patents were acquired in this country by foreigners, who carried on their manufacture abroad, importing the manufactured articles into England, and that in this way home manufacturing industries suffered, and much employment was lost to the working classes. That he believed to be true, and it was a condition

of affairs for which he should very much like to see an efficient remedy, but the question was how to cure that mischief without imposing unreasonable conditions upon the average inventor. Besides having a very liberal system of compelling the granting of licenses in return for reasonable consideration, a system which would afford widespread protection to home manufactures, it seemed to him that the Act of 1902 might be somewhat developed. That Act contained a provision which pointed in the right direction, viz., that if it be proved to the satisfaction of the Judicial Committee that the patent was worked, or that the patented article was manufactured exclusively or mainly outside the United Kingdom, then unless the patentee could show that the reasonable requirements of the public had been satisfied, the petitioner should be entitled either to an order for a compulsory license, or to an order for the revocation of the patent. If they followed that idea out, might they not reasonably come to this, that it should rest with the patentee, whose patented manufactures were being imported into this country, to show, if called upon, that the manufacture here was taking place to at least an equal extent? Could they not, for the Privy Council, substitute a much less expensive tribunal? It seemed to him that if they could arrive at that, they would wipe out the difficulty and the danger which so many people complained of. He did not suggest that compulsory licenses should necessarily be in substitution for the revocation of the patents; but what he did desire was that, unless there could be shown any exceptional reason to the contrary, the patent of a man whose patent was being worked by importing more than was being manufactured in this country, should become liable to revocation—not, however, without first ascertaining the position and giving reasonable notice that revocation would ensue if the practice were continued. He made that proviso because he thought that where it was found that patent privileges were being abused, it was reasonable that the facts should come before some responsible tribunal, in order that it might be ascertained before revocation of the patent took place, whether there was really sound and conclusive reason why the manufacture should not take place in this country. If they could give an opportunity of showing that there were commercial reasons which rendered it practically impossible that the manufacture should take place here, then that might be allowed to go, because in that case nobody would suffer, and they ought not then to revoke the patent. It was most important that patent property should be liable to as little uncertainty as possible. One of the objections to the laws of most foreign countries in which there were compulsory working provisions, was that a patentee never knew, until too late, whether he had done enough to satisfy the law, or not. That, certainly, was not a state of things that they would like to see established in this country; but he did wish to see a condition of affairs established that would give the preference to our own manufacturers, as distinguished from manufacturers carrying on business abroad. He felt very strongly in support of some reasonable system which would have that effect. With regard to the tribunal which in his view should be entrusted with questions of that kind, he was afraid he would find himself in a terrible minority, but he maintained that an authority which was charged with the consideration of applications for patents, with the question of determining whether an invention sought to be patented had been already patented, or whether it had been stolen from the person who opposed the granting of the patent, and questions of that kind, or whether an amendment which it was sought to make was reasonable and legitimate—he submitted that a tribunal which could be trusted to deal with matters of that kind could readily, if well developed, constitute an admirable and a comparatively economical tribunal for enquiring into the facts of cases in which it was alleged that importation into this country was taking place on a larger scale than manufacture here, and whether there was a reasonable excuse for that state of things. Until about two years ago the Canadian Patent-law required in all cases that manufacture in Canada should take place within a certain time from the date of the patent. For a long time, under a decision of a former Commissioner of Patents, it had been considered that so long as the patentee was prepared to grant licenses on reasonable terms, or to supply the patented article if asked for it, the law was complied with. A time came, however, when it was suddenly decided by a higher tribunal that that was not sufficient, and consequently legislation became necessary. He took the opportunity, when consulted on the subject, of suggesting the provision of a compulsory licensing system in lieu of the compulsory manufacturing provision, but in amending the law provision was made for applying to the authorities, either to have the patent put under the compulsory working clauses, or under the compulsory licensing clauses. The application so made was dealt with according to the character of the invention, and the view taken of the matter by the authorities. When a patent had been placed under the compulsory license clauses—and in that connection he should like to say that he found that practically all British and Continental applicants for Canadian patents had asked to have their patents placed under those clauses—when so placed the application for a compulsory license could be made by anybody and was dealt with by the Patent-office authorities. Canada was not the only country in which the Patent Office authorities performed analogous duties, and it seemed to him that the idea which obtained in this country, that to deal with matters after a patent was once granted the tribunal must be of a cumbersome and costly character, should be dispelled. He believed the tribunal he had suggested would be an efficient one, and that it would do its work quickly and give general satisfaction. With regard to the final

revocation of a patent in a case where it appeared that the patent ought to be revoked, he would suggest that after enquiry by the Patent Office tribunal their report might be referred to the Court. He should like to see some restriction, so that such a question would not have to go from a Court first instance to the Court of Appeal and from the Court of Appeal to the House of Lords. He thought that people of moderate means were at any rate entitled to expect some opportunity of getting justice.

Mr. JAMES ROBERTS said the author had told them that under the Statute of Monopolies patents were granted so long as they were neither "contrary to law, nor mischievous to the State by raising prices of commodities at home, or hurt of trade, or generally inconvenient." The reason why monopolies were granted at all to inventors was to reward the inventor for the good he did to the public by introducing a new industry into the country, not only by inventing a new thing, but, in the early days, the award was made for introducing a manufacturing industry into the country. They wanted to get back to that state of things, which they had drifted from for reasons now historical, such as change of trade and trade methods, change of intercommunication, and so on. The law, which at first was intended to protect British industries, had now come to be used in certain instances to protect the foreigner by the strongest protection he could have against the British workman, by having given him a monopoly to make the goods abroad and bring them into this country, and sell them at what price he could get. His suggestion was, that it would be better, as regarded compulsory working, to go to the root of the matter at once, not to enquire whether the amount of manufacture was equal or more than what was manufactured abroad, but to say at once that a patent should be liable to be revoked if the patentee imported into this country goods which, if imported by a stranger, would be an infringement. If the patent was worked at all, then it must be worked in this country. Of course, there were exceptional cases where it was impossible to work the patent in this country for commercial reasons, such as the price of raw material being too high, and in that case the onus should be on the patentee to show it, and if he did so he should get permission to import. By looking at the question from that point of view, the evil was at once reached, and all enquiries, such as whether the public were already supplied sufficiently or not, were done away with. That, suggestion, however, did not stand alone. With reference to the blocking of patents, the monopoly was intended simply to reward the inventor, and it was incidental to that reward that the inventor should have a monopoly. Now if the inventor could be rewarded by royalty without being given the evils of monopoly, he thought it was in the public interest that a change should be made. That would mean giving compulsory licenses practically to any manufacturer of standing who wanted one. If the question was looked at from this point of view, the result of it would be that there would be free competition in the manufacture. Five or ten manufacturers might apply for a license, and having got it would then compete against each other, and whatever virtue there was in free competition, the public would get the benefit of it. To the extent that the public benefited by the manufacture of new goods, to that extent proportionately the inventor would be rewarded. In this case, too, there must be a limit, and he suggested that the patentee should have a right to enquire before the license was granted as to whether the proposed licensee would be substantially able to meet his royalties. It would not do to let any bogus company get a license for the working of the invention. Another evil the author had referred to, was the tacking on to licenses of all kinds of conditions which were never contemplated originally. That evil, he (the speaker) thought arose in a very simple way. It arose from the earlier decisions, in which it was held that when a man once manufactured under his patent, and had sold his manufactured article, the purchaser of that article could do what he liked with it. The ground of the decisions was that he had an implied license to do what he liked with it by the fact of the purchase, and therefore it was implied that such implied license could be negatived by express agreement. This implication was contrary to the laws of other countries and our Colonies, which said that conditions could not be attached to personal property. He thought the remedy in that direction would be simply to enact that any breach of a conditional license should not be deemed to be an infringement, but only a breach of contract. He would not go into the question of the nature of the tribunals, because that had been discussed much better by others, but as regarded the general principle of substituting a court or a tribunal of some kind to fix licenses instead of leaving it to open competition he thought there was much to be said in favour of it. The principle was admitted in the Acts of 1883 and 1892. There was no knowing what prospect the Bill now before Parliament had of passing, but he hoped sincerely that it would pass, and that if it did credit would be given to the draftsman and the other gentlemen, who had for years past been so insistent in their endeavours to get it passed.

Professor BOYS, F.R.S., after speaking in eulogistic terms to the scholarly character of the paper, said he desired to refer generally to the questions of the compulsory license, and the harm done in this country by the power that the English Patent-law gave to foreign financial groups. Even in his small experience he had seen cases where the English manufacturer was entirely shut out by the definite determination of those who held the English patent that not a thing in connection with it should be done in this country. Departing from a consideration of the great fundamental principles which were being

discussed with the hope of a change in the law, and referring to minute details which he supposed did not necessarily require a change of law, he wished to mention the difficulty which everyone who had had to examine many specifications was only too familiar with in connection with the complicated small drawings by which they were accompanied. The drawings were made in black and white because of the process by which they were produced, the result being that when the drawing was not for a simple piece of mechanism, but for a complicated piece of machinery in which one thing was seen behind another, and that behind something else, it was necessary throughout their length following out the lines to strain the eyes so as to tell whether any individual line was the right-hand edge of something to the left or the left-hand edge of something to the right. He found it practically necessary, in order to make these drawings clear, to pick out the parts with a red and blue pencil, and sometimes also with one or two other colours, and then the whole difficulty of following what the construction really is vanishes, complication changes to simplicity. Now he wanted to ask whether modern improvement in colour printing were not available so that such drawings as he referred to could be printed where necessary in two or three colours, the patentee, of course, supplying separate drawings in black for each colour that is required, and writing upon the drawing the name of the colour. Then if certain fiducial marks were made, also in black, of course, any want of perfection in register would be indicated by the displacement of the fiducial marks upon the composite colour print. If any snch scheme could be considered practicable, the increased clearness of the drawings and facility of interpretation would be a great advantage.

Mr. EDWARD CARPMAEL did not think that Mr. Gordon had made out his case for the abolition of injunctions. All his arguments seemed to be based upon most unusual and extraordinary cases, and even as to some of those he hardly thought that the remedy was applicable. Again, legislation based on exceptional cases was proverbially unsafe. He thought also that Mr. Gordon had overlooked the fact that in many cases, although the damage done by infringement to the patentees' trade was very real, it was extremely difficult either to estimate or prove. He was, however, content to leave this branch of the subject to others more competent than himself, but would like to speak for a few minutes upon a subject which cropped up incidentally, viz., compulsory working. Mr. Gordon appeared to be a sort of half-hearted supporter of that, provided it was limited to patents which were worked abroad, but not in this country; and at the last meeting Mr. Levinstein strongly supported that view. Now he (Mr. Carpmael) did not think those gentlemen could have fully appreciated Article 2 of the International Convention. By hat article was agreed to give foreigners equal rights with Englishmen in all matters relating to patents. But as a matter of fact 99 out of every 100 patents which were worked abroad but not here were the property of foreigners. Could we, therefore, say that a law which applied only to those patents would give equal privileges and advantages to foreigners. It appeared clear that such a law was contrary to the spirit of the Convention, and indeed the advocates of the law openly said it was directed against foreigners, and especially against the Germans. If compulsory working was established in the country there were only two alternatives, either we must secede from the International Union, or the law must apply to all patents equally. He did not think anyone supported the first alternative. Indeed, the advantages this country had gained from the International Convention were so great that it would be madness to give them up. Moreover, there were grave objections to the other alternative, some of which had been mentioned by Mr. Gordon and Mr. Levinstein. Thus, as Mr. Gordon had truly said, there were many patents which it was not desirable to work in this country, either because they were for obsolete forms, or else because the article could be produced much more economically abroad so that enforcing the production of it here would entail a greatly increased cost to the consumer. Again, as pointed out by Mr. Levinstein, it took a long time to introduce a new industry, and it would be most unfair, in many cases, to deprive an inventor of all his privileges merely because he had failed to succeed in a time in which, under the circumstances, it was impossible for him to succeed. Such a law was extremely cruel to the poor inventor, who was often crippled for the want of capital. The poor inventor was thus put at the mercy of the rich manufacturer, and a typical case had just come to his knowledge. An inventor having perfected his invention, endeavoured to sell his German patent to a large manufacturer. The latter was quite willing to enter into negotiations, and expressed himself extremely pleased with the invention. But on one pretext or another he allowed the negotiations to drag along, until almost the expiration of the three years allowed for working. The manufacturer then offered about one-tenth of the value of the patent, telling the patentee, "If you do not take this, you will get nothing, for the patent will be revoked for non-working." Again, the greatest objection to compulsory working was not from the point of view of the inventor, but from the point of view of the public. So far from tending to introduce new manufactures into the country, it had an exactly contrary effect. That sounded like a paradox, but it was nevertheless true. The introduction of a new industry required the expenditure of time and money, and in almost all cases at first resulted in a loss. The very object of the Patent-law was to induce inventors and capitalists to face the initial loss by giving them a monopoly for a limited term. What would happen if there was compulsory working, and the monopoly ceased at the

end of three years if the manufacture had not been established? What inducement was there at the end of the three years for the inventor to give further time, or the capitalist to find further money, when all the fruits of success would be reaped by others? None, and the invention was consequently abandoned, often for years, and sometimes for ever. Why was it that capital was much more easily found in this country and in the United States of America for promoting the introduction and exploitation of patents than it was in France and Germany? His answer was that without doubt it was because patents in England and the States were much more secure. In Germany and France no one knew whether a patent was valid, or not, or what was or was not a sufficient working, or a sufficient excuse. He considered it childish to suggest as was done by some that all objections to compulsory working could be removed by giving the tribunal, on whom the fate of the patent depended, a discretion to accept excuses. The result of giving discretion in foreign countries was simply doubt and uncertainty, and capitalists would not find money for pushing inventions. Again, would compulsory working have the effect desired by its supporters? As he understood it the desired effect was to prevent the importation into this country of patented goods made abroad, and especially the importation of dye stuffs made in Germany. But here again the International Convention was a fatal obstacle, for by Art. 5 we had expressly agreed that no patent should be revoked owing to the importation of patented goods, and therefore compulsory working would only have the effect of causing a small proportion of the goods to be made here, whilst the balance could siill be imported from abroad, and he thought that was an answer to one of the speakers. In conclusion, Mr. Carpmael reminded the meeting that this was by no means the first time that the "compulsory working" had come before the Society. At a very full meeting six years ago, when a paper on the subject was read by Mr. Alexander Siemens, the speakers unanimously condemned the suggestion, and he trusted the Society would adhere to the opinion then expressed, and use their utmost endeavours to prevent the passing of a law which would be a serious blow to British industries by throwing doubt upon, and consequently diminishing the value of almost every patent without attaining the object of its promoters.

Sir LLOYD WISE remarked that he did not understand Mr. Carpmael's reference to the International Convention. If he rightly understood Mr. Carpmael's view he considered that Sub-section 5 of Section 3 of the Act of 1902 practically rendered it necessary that this country should retire from the International Union, because it provided that if it was proved to the satisfaction of the Judicial Committee that a patent was worked, or the patented article was manufactured exclusively or mainly outside the United Kingdom, then unless the patentee could show cause he should be liable to an order for revocation of the patent. He wished to point out that that proviso applied to all patents, whether taken by British subjects or foreign subjects; and the plan that he suggested applied in the same manner. If that involved this country retiring from the Union, so also would Sub-section 5 of Section 3.

Mr. CARPMAEL entirely agreed with Sir Lloyd Wise that the Act of 1902 was a small breach of the International Convention, but he did not think that was any excuse for following it up with a big one. Two wrongs did not make one right.

Mr. J. F. ISELIN said when he came to the meeting he thought he would represent an unpopular cause, and might even find himself in a minority of one, but after the able observations of Mr. Carpmael, he found that was not the case. His observations would, in the main, be directed to the question of compulsory working. He desired the meeting to notice that the agitation in favour of compulsory working emanated from the manufacturer, and the point of view of the inventor, particularly of the British inventor, had received no considerarion on the part of the people who were proposing the change of the law. One principle to which he desired to draw attention, which had been very much overlooked, was that the patent system was intended not for the encouragement of manufactures but of inventions, and that there was a very considerable distinction between the two. No doubt it would be found stated in the Statute of Monopolies that patents were intended for the encouragement of manufactures, but a good deal of advance had been made in the 280 years which had elapsed since then, and the best opinion of experts favoured the point he was making. He spoke as a lawyer, and a student of systems of Patent-law. Much obloquy had been cast by previous speakers on lawyers, but it could be claimed on the part of lawyers that they had no private interests to serve. It was very significant that when the point which Mr. Carpmael had made, as to the International Convention, was put to Sir Joseph Lawrence by the President of the Board of Trade, he replied that he did not desire foreigners to submit to anything which English patentees would not submit to themselves. It was plain that that meant that English manufacturers wished to have not only the foreign inventor but the English inventor also at their mercy. Sir Joseph Lawrence had also contended that compulsory working was universal throughout the world. He desired to draw attention to the fact that the United States had no system of compulsory working, and that no attempt or suggestion had ever been made to introduce such a system into the United States. It was suggested by the proposers of compulsory working that no great industry could be built up without adopting that system, and yet the United States, without compulsory working, was perhaps the most advanced manu-

facturing country in the world at the present moment. Upon the Continent of Europe, where they had much experience of compulsory working, the best opinion tended more and more to the abolition of that system. The great international society, which met periodically to discuss these matters, and had held a congress in the Hall of the Society of Arts in 1898, which included representatives from all countries of the world, though Englishmen, unfortunately, did not take their due share in its deliberations, had repeatedly by large majorities passed resolutions in favour of the abolition of compulsory working, and the substitution for it of a system of compulsory licenses, enforcing the point he was making that the best and most enlightened opinion of the Continent was opposed to compulsory working. The question of compulsory working he also desired to point out was being discussed in the dark. They had been expressly told that the Bill, which was at present under consideration, was entirely a confidential matter. It was not known in what form it was proposed to introduce compulsory working, and it seemed to him that was an extreme instance of the unscientific manner in which the work of legislation was carried out in this country. If the matter was being discussed in Germany the draft law would have been open to the public months ago, and public discussion held on it. Compulsory working could be introduced in two forms, first of all in an open form, and secondly in what might be called a latent form. Either a patent might be revocable when an action was brought forward straightforwardly for revocation, or it might be open to the infringer when sued, to set up the defence that the patent was bad because it was not being worked. The first was substantially the system in Germany and other countries; the second was the system in vogue in France; and the insecurity which it introduced into a patent must be perceived by an intelligent observer. In the case where the patent was revocable only by an action, the unfortunate inventor went to the manufacturer and asked him to adopt the invention, whereupon the manufacturer replied that he had only to wait for a few months and the patent would be void for want of working, and the invention would fall into his hands. But under the French system, the position of the unfortunate inventor was much worse. He went to a manufacturer, who immediately asked what security he had as to the validity of the patent, and argued that he could never tell whether the requirements as to working had been fulfilled in the past, and any infringer could make use of it. Therefore, the natural effect of a system of compulsory working, whether of one kind or the other, was to put the unfortunate inventor, bound hand and foot, into the hands of the manufacturer. From the point of view of the inventor he suggested that the people of this country should be very careful before introducing a universal system of compulsory working, especially remembering that power already existed under the Act of 1902, to declare a patent forfeited for non-working. The Chairman had asked him to discuss the effect of the rules under the 1902 Act. It seemed to him that the existence of the preliminary examination, which was the principal effect of the Act of 1902, did not interfere in the main with the question of compulsory working, but from the public point of view it was a good feature that a man should be prevented from imposing upon the public by means of an alleged invention which anyone who possessed a sufficient knowledge of the matter must know was a bogus invention. He desired to make one small correction to his remarks. He had said there never was a system of compulsory working in the United States, but Mr. Carpmael had drawn his attention to the fact that America once had such a system, which it abandoned for sufficient reasons.

Mr. IVAN LEVINSTEIN remarked that Mr. Carpmael had said that if compulsory working were introduced into this country a breach would be committed of Article 2 of the International Convention; but the International Convention in 1902, held at Brussels, passed the following resolution, indicating that if the compulsory working were introduced, it would not be considered a breach of the International Convention. "The Final Protocol annexed to the International Convention of the 20th March, 1883, shall be completed by the addition of No. 3 *bis* in the following terms:—3 *bis*. The patent in each country shall not be liable to forfeiture on account of failure to utilise it until after the expiration of at least three years from the date of the deposit of the application in the country concerned, and only provided the patentee cannot show reasonable cause of his inaction." That showed that the International Convention approved of compulsory working, and that no breach would be committed against Article 2 or any other article of the Convention. Mr. Carpmael also referred to the initial difficulties which the patentee had to overcome before his patent was really workable, and that it would be very hard indeed to ask the patentee to wait a time, or lose his patent. Mr. Carpmael evidently did not know the terms of the resolution of the Associated Chambers of Commerce, which did not ask for the revocation of a patent because it had not been worked within a certain number of years. The resolution said that if the invention was worked abroad, and goods were imported into this country, the patent should then be liable to be worked under certain provisos. If the British monopoly had been worked abroad and not in this country it was evident that the patentee must have surmounted the initial difficulties, and it was mere cant to say that the poor British inventor would lose his patent because he had not the money to work it. It was quite true that the International Society for the protection of industrial property, the members of which were chiefly composed of Germans and French-

men, passed resolutions seven or eight years ago advocating the abolition of compulsory working clauses in every country. He was present at the meeting, and enquired why the compulsory working clause had not been withdrawn in Germany. Even up to the present time that clause existed in Germany, and would continue to exist, to the very great disadvantage of British manufacturers. It had been stated that America, the leading manufacturing country, had no system of compulsory working, but the answer was a very simple one. With import duties of from 50 to 90 per cent., no compulsory working clause was required, because that of itself was a natural compulsory working clause. Owing to the high prohibitive duties imposed, it was impossible to import goods into the country to compete with home manufactured articles, and inventors were compelled in the majority of cases to manufacture these. It had also been argued that where compulsory working was in force the patents were not secure, but those who had any experience knew that a German patent was a better security than any other patent, so that the suggestion that in countries where there was compulsory working the patents were insecure, might be dismissed.

Mr. CARPMAEL remarked that he did not say that compulsory working was contrary to the International Convention. On the contrary, he distinctly stated it was quite open to this country to have compulsory working. What was not open to this country was to have compulsory working applied only to patents granted to foreigners.

Mr. LEVINSTEIN thought Mr. Carpmael could not have read the resolution of the Associated Chambers of Commerce, which referred not only to foreign patentees but all patentees.

Mr. BURDICK expressed disappoincment that Mr. Gordon did not express any sympathy whatever with the inventor. His sympathies went entirely to the public, who were excluded from the privileges granted by the patent. As to requiring the patentee to manufacture in England in the manner required in most continental countries, he was of opinion that the adoption of the principle was unfortunately made necessary by commercial competition. If, for instance, a German manufacturer or inventor could, by patenting in England, prevent local manufacture, and obtain the benefits of manufacturing for both countries in quantity at a single factory; while the English inventor must establish two manufacturing plants, or transfer the manufacture to Germany, in order to protect himself in the invention, the plan was manifestly unfair; and the only remedy was to adopt the same selfish course as the Continental competitor. From the inventor's point of view he wished to refer—first, to the shortness of the period for which a patent was granted in England; second, the excessive Government fees, and third, certain points of practice which seemed to him unfair. He had learned from a previous paper at the Society, that the inventor was a "visionary sort of person," whose rights in the matter of his invention were scarcely worth considering, and from whom the public should be protected. In America the founders of the Patent-law assumed that the inventor was a public benefactor, and that he should be encouraged, and very favourable laws were made to protect him in his patent rights. The American inventors led the world, and the benefits which they had brought to their own country had been very great. He had no hesitation in saying that the English inventors were not inferior to the American inventors in capacity and brain-power, but that the difference in results was due largely if not entirely to the difference in the laws of the two countries. In America an inventor is allowed two years to experiment publicly with his invention before patenting. He is allowed 17 years of protection from the time that the patent issues, and the entire cost to him was £7. In England the period was 13 years and a fraction, and the taxes for the 12 or 13 years exceeded £100. Many patents were never valuable enough to pay these exorbitant taxes. If the two years of preliminary public trial of the invention allowed by American law were not included, there is a period of about four years in favour of the American patent, which were very often worth more to the inventor than the preceding 14 years. There were certain kinds of accidental inventions, which perhaps should be classed as discoveries instead of inventions, which were perfected, and became immediately remunerative. There were some inventions, such as toys and games, which became obsolete in 14 years; but the more serious work of engineers and chemists often entailed several years of experimental work and a very considerable outlay. He could not find anything whatever to recommend the Patent-laws which came in force in 1905, to the serious inventor. It semed to him that they had been specially drafted by patent agents for their own convenience. While he had to complain about the Patent-laws, he also had a complaint to make in regard to the Patent practice. For instance, an inventor was not allowed that which was novel, and was described in his patent. He was entitled only to that which he claimed, and he was put in the peculiar position that if he claimed more than was novel, his patent became practically valueless, and was indefensible in any Court of Law. It would work no hardship to anyone if the law required a full and complete description of the invention and its application, and the inventor became thereby entitled to that which was novel in it; this was the practice in France, and should be the ruling of every Court. In making a plea for the inventor and his rights, he did not expect that very great changes would be made in his favour. He knew the difficulty of moving legislatures, but he had no doubt that the Society of Arts could affect material improvements if they choose to

throw their influence in favour of the inventor. He did not presume that a reduction in the costs of a patent could be obtained; but he pleaded that a patent should bear date from the time of issue and not from the date of application. It was a popular myth that a British patent was for 14 years. As a matter of fact no patent was granted for 14 years. The inventor had no protection from a patent until it was granted, and it was dated back to the time of his application, which might be many months before. If the American system could be adopted of giving the inventor six months to pay the final fee after the patent was granted, and the patent be valid for 14 years from the date of issue, it would be a substantial advantage to the inventor. The life of a British patent was shorter than that of any other important country, except her colonies, whose laws were modelled after her own.

Mr. Dunbar Kilburn thought Mr. Levinstein was in error in regarding a Germant patent as an infallible asset, because the granting of a German patent did not mean that it was essentially valid. He knew of many instances where German patents had been granted where, if certain material had been brought forward, it would make them not worth the paper they were written on. He desired to endorse strongly everything Mr. Carpmael had said in opposition to the introduction of compulsory working. He thought the attitude taken up by the majority of the speakers was decidedly in opposition to the bulk of inventors, many of whom would suffer pecuniary and other losses if compulsory working in any form was introduced. Certain of the speakers had hinted as he thought a cure for the present state of things, namely, not in the reform of the Patent-laws but a reform in the very difficult and tender subject of protection and free trade. Another point which had been overlooked was that he thought many inventors if they saw that compulsory working was going to be introduced would count the cost beforehand and not take out a patent in the country at all. It would then be in the power of the German manufacturer to introduce his invention without any patent at all, making his goods abroad and selling them at a price at which it would be impossible to compete, and so obtain the benefit he already possessed without any protection at all. The German manufacturer could also start a factory over here with undesirable aliens to assist him at cheaper rates of wages, and undersell in the same way as at present. No Patent-law would be of any use there. Even if compulsory working were introduced the requirements would be got round in various ways as they were abroad, the conditions being only technically complied with. He endorsed all the remarks which had been made against compulsory working, and thought a remedy was to be found in revising the compulsory license clauses, and in other directions entirely outside the Patent-law.

Mr. Gordon, in reply, after thanking the various speakers for the great kindness with which they had attacked him, said that it was impossible for him to deal in a detailed way with every speech, and he, therefore, proposed, as far as possible, to classify the various objections which had been made, and reply to the individual speakers under one or other of the particular heads. Sir Lloyd Wise, Mr. Carpmael, and Sir Joseph Lawrence stated that they were not satisfied with the argument brought forward, to show that the practice of the Courts with regard to the granting of injunctions needed amendment. They thought that people were perfectly satisfied with the present practice, and that it would be mischievous and dangerous to make an alteration. The answer to that was that the objection itself was directed not to what he had said or meant, but to something specifically different. He should be the last to snggest the abolition of the remedy by injunction, which in a proper case seemed to him to be an extremely necessary one. Sir Joseph Lawrence mentioned a case in which if the patentee had had to go through all the Courts up to the House of Lords, he would have been ruined before he obtained his remedy, but personally he did not know what the case could be in which an injunction could be obtained without giving the person restrained by it the right of appeal to the House of Lords. So far as he knew, any person who was restrained by injunction had an appeal through all the Courts up to the House of Lords. Although when the injunction was an interim one the appeal was not often taken, he was very happy to think that so serious a restriction upon their liberty of action as an injunction could not be imposed without giving the right of appeal through all the Courts to the highest tribunal of the realm. He rather inferred that the case Sir Joseph Lawrence had in his mind, was an interim injunction. If that was so, he should like to deal with the objection in that form, because it very pointedly illustrated the exact point he wished to to make. It was a very curious circumstance that when an injunction was granted for a short time the Court always exercised its discretion upon the most approved principles, considering whether it was convenient that the injunction should or should not go. Every question which affected the convenience of the public or of the parties was taken account of when the injunction was not a perpetual, but only an interim one. What he had suggested was that the same careful consideration should be given to the case when the injunction was perpetual as when the injunction was granted ad interim alone. When a perpetual injunction was granted after a trial, the Courts did not pause to consider whether there was any question of convenience involved or not. He knew there were old judgments which said that in all cases the granting of an injunction was discretionary with the Courts, but everybody acquainted with Patent-law practice knew perfectly well that the question of discretion did not arise when an action had been tried out, and, con-

venience or no convenience, the injunction was granted as a mere matter of right. As a very strong instance of the way in which that worked out he would mention an action brought a good many years ago against, he believed, the St. James's Electric Lighting Company for using the three-wire system of distribution for their electricity. The patentee, the late Dr. John Hopkinson, succeeded in his case and obtained an injunction, the terms of which required the company to shut down their works for their distribution of electricity that same afternoon, and leave the whole of their district in darkness until they had time to grub up their mains or rearrange their system so that it did not work upon the three-wire system. Dr. John Hopkinson, however, was a man of high character and public spirit and did not choose to insist upon the injunction. The injunction was granted as a matter of terms, but by his consent it was suspended until arrangements could properly be made; but the important point was that it was not a question for the Court to consider whether the outrageous inconvenience of shutting down the whole electric lighting system on the spur of the moment was a course which should follow from their injunction. His contention was that the public in such a case ought not to have to look for protection to the public spirit of a particular individual but to the law of the land. The serious inconvenience in that case was not half so serious as the inconvenience which was actually inflicted in a case of which the presence of Mr. Levinstein reminded him where an enormous industry in this country was destroyed by an improvident injunction, as a result of which a manufacturing industry was carried over to Berlin and a dyeing industry which had nothing to do with any patentee was taken over to Holland. It must not be supposed that he was dealing with hypothetical cases. Mr. Carpmael had said that extreme cases had been put forward in the paper. He (the author) acquiesced. He contended that he had put forward cases of extreme importance, extreme hardness and urgency, which called pressingly for a remedy. Mr. Levinstein had complained that he (the author) had not done justice to the resolution of the Associated Chambers of Commerce and to the Bill which had been submitted to the Board of Trade. In a sense he pleaded guilty to that charge, and his answer to it had already been suggested by Mr. Iselin, who had stated that that question was being discussed under the great disadvantage that those present did not know what the provisions of the Bill were. That was truer on the last occasion than at present because Mr. Levinstein and Sir Joseph Lawrence had referred to the general nature of the draft Bill. But even now it was impossible to form a definite opinion about the merits of the proposal without knowing more about it than was public property at the present moment; so that if he had done injustice to it, he hoped that that would be a sufficient apology. What he did feel free to say about it was, that there were certain conditions which must be fulfilled in order to do justice to the inventor. It had been stated that he had not expressed sufficient sympathy with the inventor, and had been indifferent to his claims. It was not for him to express an opinion on such a question, but, however inadequate might be his appreciation of the inventor's claims he recognised, fully that he had claims which were of urgent importance in that respect, and that any provision that would impose upon him the duty of compulsory working was one which needed to be guarded with very carefully drawn and fully matured conditions, which Mr. Levinstein assured them were satisfied in the draft Bill. He was content to take it from Mr. Levinstein that that was so, and upon that basis ventured to think that the conclusion that the meeting ought to come to was that it was not impossible that a Bill could be drafted, and a rule framed, which would meet those requirements. He quite believed it was possible, and he said so. And if that did less than justice to Mr. Levinstein's proposals he thought they must wait before doing full justice to it, until the terms of the actual Bill were seen. Passing to the suggestions made by Sir Lloyd Wise, that gentleman had said that this country possessed a very liberal system of granting compulsory licenses, as matters stood at present, and his view was that improvements in the law ought to be developed upon that basis. The meaning of that was that it was a better system than compulsory working. It would be a very large question to go into, and he would not attempt to discuss the relative merits of the two schemes at the present stage. But he desired to point out that the system which Sir Lloyd spoke of as a liberal system had proved itself to be a singularly ineffective one. Three very large volumes of reports of patent cases had been published since the Act of 1902 was passed, and there was not a report of a single compulsory license case in any of the volumes. He could not think that an Act which had had that result, whatever its liberality, could be a satisfactory piece of legislation.

Sir LLOYD WISE, interposing, stated that Mr. Gordon had misunderstood his remarks. What he wished to convey was that a liberal system of granting compulsory licenses, with an economical and readily accessible tribunal, supplemented by a provision for the revocation of patents, where, after due notice, the products imported exceeded those manufactured in this country, would meet the case. It was not his proposition that the present provisions were ample.

Mr. GORDON regretted that he had misunderstood Sir Lloyd Wise's remarks. He found it much easier to understand the case as now explained. There was one point which he made, however, about which he thought he could be under no mistake. It was Sir Lloyd's view that at any rate one important improvement of the law would be to transfer that jurisdiction

to the Patent Office. There was, it seemed to him, a fatal objection to that proposal, which had proved very formidable in two cases already; one where the jurisdiction was vested in the Board of Trade, and, secondly, where it was vested in the Privy Council. The difficulty was that an additional piece of litigation was forced upon the applicant for a compulsory license. The only time when a compulsory license was really and seriously needed, was when an individual was threatened with a patent action, or when a patent action was going to be decided against him. That was a remedy which should be made available to a man when he was before the courts and fighting a patent action. The only tribunal which could effectually deal with the question was the tribunal which had to try the issues in the action. It was an essential and elementary judicial principle that an opportunity of settling the whole controversy in one place, at one time, and by one proceeding, should be given. That was the essence of economy and efficiency in litigation. Individual tribunals might be made as economical as possible, but it was impossible to make litigation economical where an important property was at stake as when the validity of a valuable patent was under consideration. The proceedings could not be made inexpensive under those circumstances, because if the property was valuable, and it was decided to take the litigation before a crossing sweeper, leading counsel would be taken down to persuade the crossing sweeper on both sides. And pretty fees they would charge for such an exploit. That was where the expense was incurred, and not in official fees. Such valuable property was in question that patentees provided themselves with the most expensive weapons for fighting their battles, and they could not be made less expensive. If a one hundred ton gun was required, a one hundred ton price had to be paid for it, no matter whether the gun were fired at savages or at ironclads. If circuitous proceedings were introduced and multiplied the expenses must be overwhelming. The next question had been so thoroughly discussed between extrremely able combatants that it was not necessary to refer to it at length. Sir Lloyd Wise had stated that he was impressed with the danger of rendering patent property uncertain, and Messrs. Carpmael and Kilburn had corroborated what he had said in that respect; but they had been well answered by other speakers. Most of Mr. Roberts's remarks he had already replied to, but there was one which he must mention, because it had not otherwise been referred to. Mr. Roberts stated that the case of the Edison lamp, which was instanced as a case of the hardship of imposing compulsory working on a patentee, came to nothing at all, because the filaments which had superseded the originally designed filaments were themselves infringements, and that to make those infringements, was to work the patent. It was really a question of what amounted to working. If it were said that anything which was an infringement amounted to working the original patent it was perfectly clear that a new system of chicanery would be introduced. As an illustration, Edison's original patent for the telephone included also the invention of the phonograph, two absolutely distinct things. Both of them were, however, new speaking machines, and could fairly be included in that general category, being made the subject of a single patent. Suppose in such a case the inventor said that he would take all the benefits of monopoly with regard to the telephone, but would support his monopoly by working the phonograph, how was that any improvement? The phonograph was a toy, practically speaking, but the telephone was one of the first necessities of business life. Was it to be contended that because the patentee chose to mix up the telephone and the phonograph in one patent, he was to have a most oppressive monopoly of the telephone, paying for it the price of free use and adequate manufacture of the phonograph. Such a case would not bear stating. If patents were necessarily simple things granted for an absolutely single invention which could not be identified with anything else, it might be possible for Mr. Roberts to maintain his point. But in view of the actual complexity of patented inventions, it was impossible to sustain the point which he had proposed that evening. The answer was that if it was to be said that the mere working of any infringement of Edison's patent supported that patent, one would simply be setting the patent agents upon new ways of driving their coaches and four through the Act of Parliament. Some exceedingly interesting comments had been made by Professor Boys, which dealt with a subject which he (the author) was not competent to treat of, but which he had no doubt would be carefully considered at the Patent Office and receive the attention they deserved. He had already dealt with Mr. Carpmael's points so far as they affected the paper, but that gentleman raised another point as to the effect of the convention. He could not help thinking that Mr. Carpmael's criticism on the convention was to a certain extent founded on a misunderstanding of the proposal, with which Mr. Levinstein and Sir Joseph Lawrence were particularly identified, and Mr. Carpmael had supposed the compulsory working which they were proposing to introduce to be of the nature of the compulsory working obtaining under the German and French laws. It had been made quite clear that that was not so. It was very difficult to discuss such a question in the dark, and he was not in the least surprised to hear Mr. Carpmael speaking to what was not in fact the proposal which had been submitted to the Board of Trade. In a sense it was quite right to deal with the German proposal, because they had not yet seen what the Board of Trade proposed, and they certainly had seen in certain newspaper articles a very wild, and probably an altogether unauthorised statement that the President of the Board of Trade proposed to introduce during the year an Act to assimilate the English system to the German system. He had no doubt, from what Mr. Levinstein had said, that that was

an altogether mistaken view of the proposals which the President of the Board of Trade had under consideration. But at any rate, it was made public, and Mr. Carpmael, in addressing his criticism to that, was justified in saying that in the uncertainty in which all at present stood as to the form in which the proposal would be submitted to Parliament, it was necessary that the defects of the German system should be exposed. Nobody present, however, proposed the German system, or suggested that it would be applicable to the case of this country. There was one point on which he found himself very much at issue with Mr. Iselin, who had said that the more modern view was that patents were granted, not for the protection of manufacture, but of invention. He could not help thinking that if at any stage of the discussion the great importance of practical value was lost sight of, they would land themselves in the clouds altogether. It might in a sense be true, that what the Patent-law considered was invention, but the only invention which it was worth while, from the point of view of the public, to protect, was one of practical utility which was capable of being reduced to a manufacture, He, therefore, thought that the point that Mr. Iselin had made against him (the author) was rather a verbal than a substantial one. He had dealt incidentally with the very interesting remarks that fell from Mr. Kilburn. He had said all he could properly say with regard to the charge Mr. Burdick brought against him of want of sympathy with the patentee. With regard to the question of the shortness of the period of the patent and the heaviness of the fees, if he had time he thought it would be easy to show that the English system was a good deal better in those respects than the American, which led to chicanery. He did not say that chicanery was always a bad thing, but generally it was. He doubted very much the value of that chicanery which enabled a patentee in America to extend his term for four years by dilatory correspondence with the Patent Office, and in that way to secure a monopoly which, if it were right he should have it, would be very much better given by an extension of the term.

On the motion of the CHAIRMAN a hearty vote of thanks was accorded to Mr. Gordon for his excellent paper, and the meeting terminated.

Mr. G. G. M. HARDINGHAM writes :—

Mr. Gordon's paper entitled "Patent Law Reform" is a most interesting one from an historical point of view; but I must confess to having felt some disappointment when I found that the only reform he proposed had reference to the section which authorises the Court "to make such order for an injunction as it may see fit." This is a provision, the legal effect of which Mr. Gordon is far better qualified to judge than I am; but having regard to the title of the paper, I had hoped to hear Mr. Gordon's opinions and suggestions upon many other subjects in respect of which our law obviously calls for improvement.

Mr. Gordon appears to give a qualified approval to the idea of rendering the working of patented inventions compulsory, although he admits that practical difficulties arise in the application of that principle. It strikes me as fortunate that difficulties are met with and objections found to the application of a remedy which would be a thousand times worse than the disease it is supposed to cure. One cannot but admire the persistence with which Mr. Levinstein has advocated his proposal, but it is some satisfaction to those who take a broad view of the manufacturing interests of this country, to observe that he has during the last few years considerably modified his demands.

There is still a great deal to do to place British patentees in the position which they ought to occupy if the manufacturing interests of this country be made the first consideration; but to place the proprietors of patents under an obligation to work their inventions whether there exists a demand for their products or not, is certainly not one of the measures likely to conduce to the attainment of the object in view.

From the point of view of public policy, the grant of a patent should be looked upon—not as a reward to an inventor, and still less as a tax upon him—but as an encouragement to him to introduce the invention, and thus to promote industry and trade. Keeping this object clearly in view, the patentee's position should be made as easy and as safe as possible. He should be subjected to no harassing conditions, particularly such as are of a perfectly futile character, as, for instance, the compulsory working of his invention. He should not be taxed beyond what is actually required for defraying the expenses of the Patent-office, and even as to that, it would probably pay the country better if the Patent-office made a loss, instead of a profit. A British patent, maintained for the full term, costs a patentee, in Government taxes alone, an average of £7 per annum. A United States patent costs, in Government taxes, 8s. 4d. per annum. Which has been of most benefit to the community at large? The eight shilling wise, or the seven pound foolish policy? It cannot for a moment be doubted that the United States policy is the right one, and that it has been of incalculable benefit in fostering the mechanical genius, and the manufacturing industry which directly results therefrom.

In the recently introduced examination system some attempt has been made to secure a little more respect for British patents as regards the novelty of the inventions claimed, but it is after all but a poor attempt; the examination prescribed by the Act being so limited in character, as to render the result, in numberless cases, utterly misleading. It is quite as common to find an invention anticipated by a United States specification as by a British specification, and yet the former are not included in the examination at all.

The British inventor is at another disadvantage by

reason of the term of his patent being limited to 14 years; this term being reckoned moreover from the date of the application for, as distinguished from that of the grant of, his patent. In Continental countries the term is from 15 to 20 years; in the United States 17 years; and in Canada 18 years. Why should the British inventor be handicapped in this manner as compared with foreign inventors? I have for many years advocated a plan for the grant of letters patent whereby the term of provisional protection — if one must have one — is separate from, instead of being included in, the term for which the patent is granted, the latter running from the date of lodging the complete specification and applying for letters patent. This term ought, moreover, to be 16 or 17 years, in order to put British inventors on a par with foreign inventors.

These are a few of the points in respect of which our Patent-law calls for reform. There are others, but I have already occupied sufficient of your time.

DECLINE OF THE CHINA TEA TRADE.

China held the tea trade of the world from 1678, when tea was first introduced into England in a small way, until 1837, when tea from India appeared as a rival. The total exports of tea from China reached their highest point in 1886, according to the American Consul at Foochow, when the amount reached 300,000,000 pounds. From that time to the present, a gradual decline is to be noted. In 1884 the tea consumption of the non-tea producing countries of the world was 372,000,000 pounds. Of this amount China furnished about 72 per cent., India and Ceylon 18 per cent., and Japan and Formosa about 10 per cent. During the succeeding twenty years the world's consumption almost doubled. Of the 644,000,000 pounds consumed in 1904, however, India and Ceylon contributed 60 per cent., China 30 per cent., and Japan and Formosa 10 per cent. The important British market, which in 1860 took 78,000,000 pounds of Chinese tea, began at that time to use the India and Ceylon product appreciably. In 1905 the British tea consumption was 260,000,000 pounds, or 6 per capita, of which China supplied about 2½ per cent., the enormous Indian and Ceylon increase having practically driven Chinese teas out of the market. The same is true in Australasia, where the per capita consumption has now reached the high mark of 8 pounds per annum. In 1895, Australasian tea purchases were 36,000,000 pounds, China supplying less than 2 per cent. China's tea trade with Russia is the only phase that has shown a steady, healthful growth. In 1899 Russia took 132,000,000 pounds of China tea, or over one-half of the total exported. Even there the India and Ceylon tea merchants are trying to obtain a strong foothold. The Russian peasant wants a cheap tea, and if Indian exporters can reach this class they will establish themselves in the Russian market. The per capita consumption of the United States in 1905 was about the same as fifty years ago, namely 1·3 pounds per annum, the increased population accounting for the increased imports, which last year amounted to 103,000,000 pounds. Up to 1865 China supplied all of the tea consumption in the American market, but in 1905 only 40·3 per cent., while Japan furnished 32 per cent., Formosa 17·2 per cent., and India and Ceylon 10½ per cent. The latter made its entry into the American markets in 1885, with sales of 2 per cent. of the total imports. Practically all Japanese teas go to America. It may be noted that India and Ceylon teas are competing very strongly with the Japan teas in the Canadian market, and it will be interesting to note the results of this competition. The Formosan tea trade with America shows a steadier and more healthful growth than that of any other country. The Formosa oolongs have entirely replaced the Amoy oolongs. Chinese teas are still popular in the United States on account of the small amount of tannin in the leaves. That the American tea market is capable of great development is not to be questioned. The American taste has been towards coffee, the consumption of this article having increased from 2·8 pounds per capita in 1830 to 11·8 pounds in 1899. Coffee drinking is more expensive than tea in America, according to the Consul, and proper methods of advertising China tea in America would very probably bring profitable results. The Imperial Maritime Chinese Customs have repeatedly criticised the careless native methods adopted in the growing and preparing of the leaf. It is contended that machine rolling is not adapted to the China leaf, but there is much that the country can do towards improving the methods. A visit to the once famous tea districts near Foochow shows that the tea plants are not cared for as they should be. They are not well pressed, and frequently the soil is over-taxed by the planting of potatoes and beans. Co-operation on the part of buyers might do much to prevent illicit practices on the part of the packers, and assist in keeping up the standard. The Consul adds, "While there is so much progress in establishing modern schools in China, there should be something done towards establishing agricultural schools, where the proper methods of cultivating the two staples, tea and silk, could be taught."

PANAMA TORTOISESHELL.

The hawk's bill turtle, or imbricated turtle, which furnishes the tortoiseshell of commerce, is found only in the Gulf of Mexico and Caribbean Sea. This turtle is recognised by the low, wide head, a long narrow mouth, the upper jaw prolonged, and hooked like the beak of a hawk. The shell is flattened and serrated behind with five vertebral and eight lateral plates overlapping one another like scales of a fish.

The colour is yellowish above, mottled with chestnut brown, and yellowish white below. Young turtles have a black spot on the four rear pairs of plates. Old turtles have a thin yellow plate on the belly, which is much sought after, and commands a higher price. This hawk's bill turtle feeds on seaweed, crabs, &c. According to the American Consul at Colon, the shells shipped from his district are taken from turtles caught on the Lagarto and San Blas coasts of the Caribbean Sea during the months of May, June, July and August, when they approach the shore to deposit eggs, which are laid on the sandy beaches above high water mark at night; holes are dug about one foot and a-half deep, and the eggs deposited therein; generally about three layings are made, during a period of nine weeks. The eggs are lightly covered with sand, and left to be hatched out by the heat of the sun. The turtles are caught either while on shore or in the water by means of nets. As a rule they are killed immediately after being caught, cleaned, and the shell-frame washed with sand. On the San Blas coast, however, the Indians do not kill them, but at once proceed to remove the shell by subjecting the turtles to great heat, afterwards throwing the turtles back into the sea. By the application of heat the successive plates of shell come off very easily. Turtles caught in these waters vary in size from one to to four and a half feet long, with a maximum weight of one hundred and fifty pounds, and the average weight of shell obtained from each is from six to seven pounds. The commercial value of tortoiseshell depends upon the thickness and size of the plates rather than upon the brilliancy of the colours. The price of shell in the Panama market fluctuates from 12s. 6d. to 25s. per pound. As the best prices are obtained in England, the largest amount of shell shipped from Panama comes to this country. The San Blas Indians, however, sell a large amount of shell to coasting steamers. During the year 1905, the total amount of tortoiseshell shipped from Colon to all countries was estimated at 16,000 pounds.

THE BELGIAN TANNING INDUSTRY.

The tanning industry of Belgium is now one of considerable importance. Not only do the Belgians work the native skins, but they import about fifty tons annually. Belgium contributes annually to this industry about 800,000 skins, which include ox, horse, buffalo, kid, and sheep skins, and the imports are chiefly from Argentina, Uruguay, Brazil, France, Holland, and Germany. Australia and South America send in sheepskins tanned, as well as fleeces, which are clipped after arrival. For several years past chrome has been used for tanning with considerable success. The large hides are tanned with oak bark, or the extracts of oak, quebracho, &c. Kid and sheep skins intended for fine work are treated with sumach; those for chamois leather work are treated with fish oil; while dressed hides are tanned with alum and salt mixed with the yolks of eggs and flour. The materials for fine tanning work are produced in Belgium, such as oak bark and certain extracts. Most of the materials required are, however, imported. Sole leather is manufactured throughout Belgium, but the leading centres are Stavelot, St. Hubert, Laroche, Namur, Peruwelz, and Soignes. Strap leather is manufactured in Liège, Verviers, Herve, and other places adjoining. Skins for gloves are tanned at various places throughout the kingdom. About sixty establishments are employed in the dressing and dyeing of skins. The importation of hides into Belgium in 1905 was valued at over £4,000,000, of which amount, those to the value of £3,600,000 were for Belgium use, the balance passing to other countries. The exports in the same year amounted to £3,200,000, of which £2,700,000 worth was from Belgium, the balance passing through from other sources.

SCHOOL HYGIENE.

The second International Congress on School Hygiene will be held in the University of London Imperial Institute City Technical College, South Kensington, from August 5th to 10th, 1907, under the presidency of Sir Lauder Brunton, LL.D., M.D., V.-P.R.S. The first Congress was held at Nuremberg in Easter week, 1904. It was attended by about fifteen hundred delegates representing almost every civilised State. The influence of this Congress has already made itself felt in many countries in the literature, laws and regulations connected with health and education.

The following is a list of the special sections formed at the Nuremberg Congress, which will also, subject to any modifications that may appear desirable, be those into which the work of the London Congress will be divided:—

1. The physiology and psychology of educational methods and work.
2. Medical and hygienic inspection in school.
3. The hygiene of the teaching profession.
4. Instruction in hygiene for teachers and scholars.
5. Physical education and training in personal hygiene.
6. Out of school hygiene, holiday camps and schools. The relations of the home and the school.
7. Contagious diseases, ill-health, and other conditions affecting attendance.
8. Special schools, including those for feeble-minded and exceptional children.
9. Special schools for blind, deaf, dumb, crippled and invalid.
10. Hygiene of residential schools.
11. The scaool building and its equipment.

ARTS AND CRAFTS.

Glass.—It is with a feeling of distinct relief that, at this time of year in particular, we turn away from the shop windows, which have been filled to overflowing for the last couple of months with "Christmas Presents and New Year Gifts," and goods at "Lowest Sale Prices" (in other words, with articles which it is fondly hoped look worth more than the money paid for them), and direct our attention to the exhibitions of artist-crartsmen, or of firms who have some care for art and craftsmanship, at the smaller galleries. Not that good workmanship, or even good art, is never to be found in the shops; indeed, it would be saying little for the Arts and Crafts movement as a whole, to suggest that it had no really direct influence on the ordinary commerce of the country. Still, it must be admitted that, at any rate during the months of December and January, what is good is mixed up with so much that is bad, that to search for it is not unlike looking for the proverbial needle in the bundle of hay. This is very markedly the case with glass. There is something very attractive at first sight in the brilliant hues and the bright and rather glittering colours of much of the cheap imported glass which is displayed for sale now-a-days. Its opalescence and its gorgeousness of colour do indeed *sautent aux yeux*. But after a while the aggressiveness of the colour, its rather metallic quality, and a certain subtle lack of refinement begin to tell, and it is with a sense of restfulness and of relief that we look at the delicate and graceful work which is being done by the Whitefriars Glass Works. Nothing could be further removed from loudness, or from any desire to be conspicuous at all costs than the delicate colouring, the restraint—both in the shapes of the blown vases and in the use of cutting—which characterise Messrs. Powell's work. Amongst the objects recently shown at the Fine Art Society there is not quite so much cut glass as might have been expected from the exhibit last year at the Arts and Crafts. What there was, however, shows that the makers are still in the main working on the same lines, and decorating fairly thin bowls and vases with slight cutting—and with very good results. The one piece of more heavily cut glass, a copy of an eighteenth century Waterford bowl, is interesting as representing a phase of cutting which, though much more elaborate than the early Roman and other work imitated before, is yet a long way off the facetted surfaces of a still later period. The latest blown vases include reproductions of old forms, both from old vases and from pictures by masters like Van der Velde and Ghirlandajo, adaptations of ancient designs, and copies of earthenware and other shapes in glass. Two or three pieces from South American models are decidedly unusual. These examples, together with a copy of the Mount Carmel vase at the Dublin Museum, serve to indicate the wide range from which the copies and adaptations of old work have been gathered. In the Minoan Lily vase, adapted naturally from a discovery at Crete, and in several other pieces, we have examples of delicate engraving on glass. The collection also included vases decorated with elongated "prunts" and thin threads of delicately coloured blue, or purple, or white glass—and a certain number of vessels mounted in silver. This metal, by the way, seems far more in keeping both with the colour and the form of this fragile-looking blown glass than the iron which was used with it some years back—which always seemed too heavy and clumsy for the material it framed.

Pottery.—Lustre has for some time past been a powerful magnet to potters, and it is towards lustre that, so far as their pottery is concerned, the Pilkington Tile and Pottery Company have been turning their attention of late. Lustre has, of course, been with us now for a good number of years. The process, after being apparently lost or disregarded for centuries, reappeared in our own time in the latter half of the nineteenth century. Everyone with any pretentions to knowledge is familiar with the work of Mr. de Morgan in this country, if not with that produced on the Continent by Cantagalli, Clément Massier, Szolnay, and others. The earlier attempts at lustre, however, were mainly either efforts to obtain iridescent colour, simply as colour, or aimed rather at reproducing or re-introducing the effects already familiar in Persian, Hispano-Moresqne, or Italian majolica work. Of late years, however, potters have been experimenting largely in the direction of glazes, in fact, it may be fairly said that modern advance in the matter of artistic pottery has been mainly in the introduction of new glazes, through the increase of chemical knowledge. Some of these, of course, are revivals of glazes apparently long since lost or only known in the East—but by far the greater number are new—composed either of ingredients unknown to the old master potters, or of known ingredients in hitherto unknown combinations. It is thus that the modern potter has a chance of producing effects in lustre such as it has never before been possible to obtain; for his choice of background colour instead of being rigidly restricted is almost unlimited. Previous exhibitions of Messrs. Pilkington's Lancastrian pottery have shown us how varied and how perfect are the glazes which Mr. Burton has produced for the decoration of his ware. The latest show of his work at the Fine Art Society has proved that on many of these glazes he can get fine iridescent and lustrous colour—which means, of course, that he can obtain a great number of quite new effects. Unlike the work shown last year at the Arts and Crafts, the pieces in the recent exhibit are almost all of them painted—sometimes with set patterns but more often with conventional designs or figure subjects painted straight off on to the pieces they decorate. If this is only the beginning of what modern lustre may attain to, there seems every prospect of achieving in this "commercial" and "inartistic" twentieth century something which we may justly look upon as an artistic triumph.

OBITUARY.

THOMAS R. DALLMEYER.—Mr. T. R. Dallmeyer died on Christmas-day last, after a short illness. Mr. Dallmeyer, who was born in 1859, became a Member of the Society of Arts in 1887. In 1893 he read a paper on Telephotography, for which he received the Society's medal. Mr. Dallmeyer's father—Mr. J. H. Dallmeyer, who married a daughter of Andrew Ross, the well-known optician —was the founder of the firm which bears his name, and which was carried on by him until 1884, when shortly before his death he resigned it to his son. Mr. J. H. Dallmeyer was one of the first opticians to turn his attention to photographic lenses, in the production of which he made many important improvements. His son carried on the business on the same lines, and himself introduced several novel forms of lenses, the most important of which was the telephotographic lens, first made in 1891. Mr. Dallmeyer was an active member of the Royal Photographic Society, and its President from 1900 to 1903.

HON. SIR JAMES FRANCIS GARRICK, K.C.M.G., K.C.—Sir James Garrick, who was a member of the Society of Arts since 1886, died at his London house on Saturday, 12th inst. He was born at Sydney in 1836, and early in life he became a partner of the late Chief Justice and Premier of Queensland, Sir Charles Lilley, as a solicitor at Brisbane. He was called to the English Bar in 1873, and shortly afterwards returned to Queensland. He held the office of Crown Prosecutor from 1874 to 1877, Attorney-General for Queensland in 1878 and 1879, and Post-master-General 1884. In the latter year he was appointed Agent-General in London for Queensland, which office he held until 1888. In 1890 he was re-appointed and continued as Agent-General until 1895. Sir James was a member of the governing body of the Imperial Institute, and director of several companies.

GENERAL NOTES.

THE CONSUMPTION OF TEA.—Figures given by Messrs. Gow, Wilson and Stanton in their annual review of the tea trade show that the reduction of the duty on tea from 6d. to 5d. has had an immediate and considerable effect upon the consumption of tea in the United Kingdom, which for 1906 was 10,345,233 lbs. ahead of 1905. During the ten years from 1890 to 1899, when the duty stood at 4d. per lb., there was an average increase in the consumption of nearly 5,000,000 lbs. per annum. This expansion ceased so soon as the 6d. duty was felt, and it was not until last year that any appreciable advance took place. It has been contended by experts that "saturation point" has been reached as regards the use of tea in this country. At 6 lbs. *per capita* the consumption is higher than in most countries, but the figures for 1906 show that the maximum consumption has not been reached. Were the duty lowered to the old figure of 4d., or lower, it is probable that the consumption would show a substantial increase. A feature of the past year was the use of a better class of tea, and consequent neglect of poorer kinds.

SANTA CATHARINA.—Little is heard of this island and state of Brazil, but it may be gathered from Mr. Vice-Consul Chaplin's report upon it (Cd. 2,682), that it is a thriving little place. The population of the capital is about 13,000, and of the whole island 33,000. It is about the size of Barbados, very healthy and suitable for the cultivation of coffee, bananas, onions, mandioca, manicoba, rice, cotton (of good quality), oranges, beans, potatoes, and in fact every kind of agricultural produce. It is a little hot in the summer, when the temperature varies from 78° to 99° Fahr. in the shade, but in the winter it ranges from 80° to 50°. The island is well situated for the exportation of its products to the great consuming markets of Santos, Rio de Janeiro, and the River Plate. Steamers drawing up to 13½ feet can enter the town anchorage, and those drawing more can anchor about five miles from the town in the North bay, in the good anchorage off Ratones island.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 23.—"The Panama Canal—the 'Lock Canal' type and the 'Straits of Panama' type." By PHILIPPE BUNAU-VARILLA, formerly Chief Engineer of the Panama Canal Company. SIR JOHN WOLFE-BARRY, K.C.B., F.R.S., will preside.

JANUARY 30.— "Apprenticeship." By JAMES PARSONS, M.A. SIR WILLIAM BOUSFIELD, M.A., LL.D. will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

JANUARY 24.—"The Bhils of Western India." By CAPTAIN E. BARNES, Indian Political Department. SIR WILLIAM LEE-WARNER, K.C.S.I., will preside.

FEBRUARY 14.—"The Practical Side of Famine in India." By SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., late Chief Commissioner of the Central Provinces.

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

JANUARY 29.—"Artistic Treatment of the Exterior of the Pianoforte." By WILLIAM DALE, F.S.A. T. G. JACKSON, R.A., will preside.

FEBRUARY 19.—"Joinery and Furniture Making." By A. ROMNEY GREEN. HALSEY RICARDO will preside.

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

LECTURE I.—JANUARY 28.—*Alluvial Gold Mining.*—Small scale methods and manual appliances—Hydraulic sluicing — Gold dredges; chief types; ground to which suitable; costs—The deep leads of Australia; their nature; distribution; methods of discovery and mining.

LECTURE II.—FEBRUARY 4.—*Lode Mining.*—The term "reef" used both for ore and "country" rock—The chief types of gold-bearing lodes—The importance of ore genesis in reference to mine development—The chief gold fields of the world and their structures—The Rand and its banket.

LECTURE III.—FEBRUARY 11.—*Gold Production.*—The crushing of the ore; the stamp mill—The extraction of gold by amalgamation; smelting; chlorination and cyanidation—Reforms in consequence of the tube mill and the filter press—Tube mill *versus* pan—Proposed abolition of the stamp battery—The depth of ores; surface and secondary enrichment—Mining costs and gold mining organization.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.
February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.
April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 21...British Architects, 9, Conduit-street, W., 8 p.m. Sir L. Alma-Tadema and Mr. W. Brindley, "Marbles: their Ancient and Modern Applications."
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. Canon Girdlestone, "The Scriptural Idea of Miracles."
London Institution, Finsbury-circus, E.C., 5 p.m. Mr. C. Harrison Townsend, "The Art of Pictorial Mosaic."

TUESDAY, JAN. 22...Royal Institution, Albemarle-street, W., 3 p.m.
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. James Tayler Milton, "Internal Combustion Engines for Marine Purposes."
Anthropological, 3, Hanover-square, W., 8½ p.m. Annual Meeting.

WEDNESDAY, JAN. 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Philippe Bunau-Varilla, "The Panama Canal—The 'Lock Canal' type and the 'Straits of Panama' type."
Geological, Burlington-house, W., 8 p.m.
United Service Institution, Whitehall, S.W., 3 p.m. Mr. A. H. Cheatle, "Gun Deafness."
Entomological, 11, Chandos-street, W., 8 p.m. Annual Meeting.
Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

THURSDAY, JAN. 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Capt. E. Barnes, "The Bhils of Western India."
Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
London Institution, Finsbury-circus, E.C., 6 p.m. Dr. Edmund Gosse, "The Novels of Benjamin Disraeli."
Royal Institution, Albemarle-street, W., 3 p.m.
Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Clifford C. Paterson, "Investigation on Light Standards and the Present Condition of the High-Voltage Glow Lamp."

FRIDAY, JAN. 25...Royal Institution, Albemarle-street, W., 8 p.m. Weekly Meeting, 9 p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. C. A. Ablett, "Alternating-Current Commutator Motors."
North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m.
Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Clinical, 20, Hanover-square, W., 8½ p.m.
Physical, Physics Laboratory of the Royal College of Science, Imperial Institute-road, South Kensington, S.W., 5 p.m. 1. Mr. W. A. Scoble, "The Strength and Behaviour of Brittle Materials under Combined Stress." 2. Mr. F. Twyman, "A Spectrophotometer." 3. Mr. K. J. Tarrant, "Photographs of Electric Sparks."

SATURDAY, JAN. 26...North-East Coast Institute of Engineers and Shipbuilders, Newcastle-on-Tyne, 7½ p.m. (Graduate Section.) Paper by Mr. W. J. Sedcote.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, JANUARY 28, 8 p.m. (Cantor Lecture.) PROFESSOR JOHN WALTER GREGORY, D.Sc., F.R.S., "Gold Mining and Gold Production." (Lecture I.)

TUESDAY, JANUARY 29, 8 p.m. (Applied Art Section.) WILLIAM DALE, F.S.A., "Artistic Treatment of the Exterior of the Pianoforte."

WEDNESDAY, JANUARY 30, 8 p.m. (Ordinary Meeting.) JAMES PARSONS, M.A., "Apprenticeship."

Further details of the Society's meetings will be found at the end of this number.

INDIAN SECTION.

Thursday afternoon, January 24; SIR WILLIAM LEE-WARNER, K.C.S.I., Vice-President of the Society, in the chair. The paper, "The Bhils of Western India," by CAPTAIN E. BARNES, was read by H. M. BIRDWOOD, C.S.I., LL.D.

The paper and report of the discussion will be published in a future number of the *Journal*.

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

The following is a complete list of the *Vivâ Voce* Examinations held during 1906:—

Place of Examination.	Date.	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French:—					
Acton and Chiswick Polytechnic	March 13.	39	3	28	8
Crouch-end Council School	March 14.	50	3	36	11
Willesden Polytechnic	March 15.	24	1	18	5
Manchester Education Committee	May 21.	21	5	10	6
Regent-street Polytechnic (Candidates from London Polytechnics)	June 7.	39	6	26	7
Kensington College (Candidates from London Polytechnics)	June 8.	43	5	26	12
"Barnsbury Park" L.C.C. School	July 2.	41	5	31	5
"Hugh Myddelton" L.C.C. School, Clerkenwell	July 3.	20	2	13	5
L.C.C. Evening School, Sussex-road, Brixton	July 4.	34	4	24	6
L.C.C. Evening School, Queen's-road, Dalston	July 5.	21	5	14	2
L.C.C. Evening School, Plough-road, Clapham Junction	July 6.	28	6	15	7
Merchant Venturers' Technical College, Bristol	July 10 & 11.	94	4	59	31
German:—					
Willesden Polytechnic	March 29.	17	4	7	6
City of London College (Candidates from London Polytechnics)	June 12.	34	9	16	9
"Barnsbury Park" L.C.C. School	June 25.	24	0	8	7
L.C.C. Evening School, Sussex-road, Brixton	June 28.	12	2	5	5
L.C.C. Evening School Queen's-road, Dalston	June 29.	15	6	6	3
Merchant Venturers Technical College, Bristol	July 17.	38	3	19	16
Spanish:—					
Manchester Education Committee	May 23.	10	—	5	5
City of London College (Candidates from London Polytechnics)	June 11.	22	2	9	11
"Hugh Myddelton" L.C.C. School, Clerkenwell	June 28.	10	—	4	6
Italian:—					
Regent-street Polytechnic (Candidates from London Polytechnics	June 7.	8	—	6	2
		644	84	385	175

The Examiners were Mr. E. L. Naftel for French, Professor H. G. Atkins, M.A., for German, Professor Ramirez for Spanish, and Professor Luigi Ricci for Italian.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ARTIFICIAL FERTILISERS: THEIR NATURE AND FUNCTION.

By A. D. Hall, M.A.,
Director of the Rothamsted Experimental Station, Lawes Agricultural Trust.

Lecture V.—Delivered December 17th, 1906.

Coming now to the last division of my subject—the Potassic fertilisers—I have to deal with a class of manures which have only assumed their present importance comparatively recently, and even now are not employed by the ordinary farmer to anything like the extent he makes use of nitrogen and phosphoric acid compounds.

The fertilising properties of wood ashes, formerly the only source of potash compounds, have long been known, but the quantity available in a country like our own is trifling; it has only been with the opening up of the deposits in the Stassfurth district that the potash compounds have assumed any economic importance. There, under conditions analogous to our own rock salt deposits in Cheshire, have been laid down beds, not only of gypsum and rock salt, but associated with them other beds containing the sulphates and chlorides of potassium and magnesium. By suitable treatment of these deposits are obtained, for commercial purposes, potassium sulphate and chloride in various grades of purity, as well as a still more impure mixture of sulphates and chlorides, sold as "kainit," and containing 12-13 per cent. of potash. These commercial potash compounds are nearly all deliquescent, owing to the magnesium chloride which is always associated with them. For some crops and soils chlorides are harmful, but the bad effect can always be obviated by putting on the kainit or other compound in the winter, when the potassium is arrested by the soil while chlorine is washed out in the drainage water. Little loss of potash will result. Dr. Dyer's examination of the Broadbalk soils at Rothamsted shows that the greater part of the potash which has been applied as manure during the last fifty years and has not been removed in the crop still remains in the surface soil, though some has been washed down and caught in the second and even the third layer of nine inches, in a manner that was not seen in the case of phosphoric acid. The drainage waters again show but little potash removed even from the most highly manured plots.

I have already indicated in the first lecture that in some way potash is necessary to the process of assimilation, and that the manufacture of carbohydrate will not go on in its absence. Some experiments of Hellriegel and Wilfarth with barley illustrate this function of potash very clearly. They started a series of water cultures, in one of which the supply of nitrogen increased in successive jars from nothing to the full amount required for the plant, the other constituents were fully supplied in every jar. In a second series, the phosphoric acid supply was similarly varied, and in a third series the potash. As would be expected, in each series the amount of dry matter grown was roughly proportional to the supply of the constituent which was in defect. Further, when nitrogen or phosphoric acid was lacking the formation of grain was small, but, as far as might be, the grains produced were perfect; a larger number of grains, but not bigger ones being found as the supply of phosphoric acid increased. Hence the weight of a single grain was fairly constant whether there was much or little nitrogen and phosphoric acid. But when potash was lacking the individual grains were small and undeveloped, and the average weight of each corn increased with each addition of potash. In the absence of potash the assimilation process was at a standstill, hence the grains could not be filled with the starch which is their main constituent. The following Table shows the total dry matter, the percentage of grain, and the weight of a single corn in each experiment of the three series:—

TABLE XXII. — Growth of Barley with Increasing Amounts of Nitrogen, Phosphoric Acid, and Potash. (Hellriegel and Wilfarth).

Nitrogen Series—Other Constituents in Excess.

Nitrogen Supplied.	Dry Weight of Produce.	Corn, Per Cent.	Weight of the Corn.
Mgms.	Grams.		Mgms.
0	0·7	11·9	19·5
56	4·9	37·9	27·0
112	10·8	38·0	33·0
168	17·5	42·6	32·0
280	21·2	38·7	31·5

Phosphoric Acid Series—Other Constituents in Excess.

Phosphoric Acid Supplied.	Dry Weight of Produce.	Corn, Per Cent.	Weight of the Corn.
Mgms.	Grams.		Mgms.
0	1·9	—	—
14·2	8·3	22·4	27
28·4	12·6	31·8	29
56·8	19·5	38·4	38
85·2	19·5	41·6	34
113·6	20·2	43·8	41
142	18·7	41·3	38
213	17·8	40·1	30
284	31·3	43·4	34

Potash Series—Other Constituents in Excess.

Potash Supplied.	Dry Weight of Produce.	Corn, Per Cent.	Weight of the Corn.
Mgms.	Grams.		Mgms.
0	2·3	—	—
23·5	5·4	4·8	5
47·0	9·0	21·5	9·5
70·5	11·6	27·2	13
94	15·3	30·1	17
188	21·2	38·5	26
282	29·8	42·8	34

The Rothamsted results with barley are less striking because of the large amount of potash originally in the soil; it is only during the later years, as has already been explained, that any deficiency of potash has been manifest on the plots that do not receive this fertiliser. Still, as shown in the following Table, which gives average results for the fourteen years 1889-1902, the use of potash has increased both the weight per bushel and the weight of the individual corns:—

TABLE XXIII.—ROTHAMSTED BARLEY.
(14 years, 1889-1902.)

Plot.	Manuring.	Weight per Bushel.	Weight of 100 Grains.
		lb.	Grms.
1 A	Nitrogen only	52·3	4·03
2 A	Nitrogen and Phosphoric Acid	52·2	3·86
3 A	Nitrogen and Potash	53·3	4·14
4 A	Nitrogen, Phosphoric Acid, and Potash	53·8	4·21

The effect of potash manuring on the production of carbohydrate, in this case sugar, is most manifest on the mangel crop. In Table II. (p. 135) one instance has already been given; Table XXIV. shows the effect of potash when used in conjunction with dung and various original nitrogenous cross dressings.

TABLE XXIV.—ROTHAMSTED MANGELS.
(12 years, 1895-1906.)

Manufacturing.	No Potash.	+ Phosphates and Potash.
	Tons.	Tons.
Dung only	18·6	19·5
,, and nitrate of soda ..	27·7	26·8
,, and ammonium salts..	21·8	25·9
,, and rape cake........	24·9	28·6
Dung, rape cake and am. salts	24·2	29·9

Here it will be seen that potash increased the crop in every case except where nitrate of soda had been used as the nitrogenous cross dressing, in which case the soda liberates so much potash from the soil that specific application of potassic manures is unnecessary. An earlier series of experiments showed that phosphatic manures added to dung brought about no increase of crop, hence, when both phosphates and potash were used in the second series of trials the potash alone was effective.

This result was the more striking in that dung itself contains a large proportion of potash, yet the use of 14 tons of dung per acre year after year, beginning in 1856, was still unable to supply the mangel crop with all the potash it needed.

Another very striking effect of potash, which is most manifest when the fertiliser is applied to grass land carrying a mixed herbage, is the way it encourages the growth of all leguminous plants. On the Rothamsted grass land, which is mown for hay every year, one plot gets a complete mineral manure—phosphates and sulphates of potash, soda and magnesia; the adjoining plot receives the same phosphoric acid, magnesia and soda, but no potash. The following Table shows the comparative yield and the composition of the herbage by weight:—

TABLE XXV.—ROTHAMSTED HAY CROP, WITHOUT AND WITH POTASH.

Plot.	Manuring.	Dry hay. 1856 to 1902.	Dry hay. 1893 to 1902.	Composition of herbage in 1903. Grasses	Composition of herbage in 1903. Legu.	Composition of herbage in 1903. Weeds.
		Cwt.	Cwt.	%	%	%
7	Complete mineral manure	38·8	36·5	20·3	55·3	24·4
8	Ditto. without potash	28·1	21·6	28·8	22·1	49·1

On the plots receiving a mineral manure including potash, half the vegetation now consists of leguminous plants. Where nitrogen is applied and potash omitted, no leguminous plants are to be found.

On these grass plots another very striking effect of potash manuring is also manifest, which confirms on a large scale the experiment of Hellriegel and Wilfarth's already quoted. On the potash-starved plots the grasses fail to a large extent to develop any seed, so that the heads are soft and barren, presumably because of the deficiency in carbo-hydrate formation. For the same cause the straw, not only of the grasses, but on the similarly-manured wheat and barley plots, is always weak and brittle when potash is wanting. One of the most important effects of potash upon vegetable growth is to make the plant more resistant to the attacks of fungoid diseases. I have already explained how susceptible the use of excess of nitrogenous manures renders the mangels on certain of the Rothamsted plots to the attack of a leaf spot fungus—*Uromyces betar*. The attack is, however, much less severe on the plots receiving an abundant supply of potash; there the plant remains healthy even though the nitrogen is in excess. Just in the same way the wheat on the potash-starved plots is always subject to rust, even in a good season when very little is to be seen on the other plots normally manured. The grass also on potash-starved plots is attacked by various fungi, hence it may be taken as a general rule that crops which do not receive their full supply of potash will be correspondingly susceptible to disease.

It is not possible to say whether this is due to any specific alteration in the composition of the cell contents or to a general lack of vigour, but the latter is probable, because an excess of potash tends to prolong the vegetative growth of the plant and to delay maturity. Plants receiving potash are always a little the greener, especially late in the season, and this is not always an advantage, as may be seen from the fact that the barleys grown on the plots receiving potash at Rothamsted show a somewhat darker and less attractive colour than those grown without potash. That potash tends to prolong growth may also be inferred from the fact that its effect upon the yield is always most pronounced in dry seasons. Referring again to Table XX. (p. 226), it will be seen that in the dry season of 1893 the yield of barley (grown also with ammonia salts and superphosphate) was increased by a dressing of potash from 18·1 to 30·8 bushels per acre, whereas in the wet season of 1894 the increase was only from 34·9 to 41·4 bushels per acre.

The examples I have been giving to illustrate the specific action of potash must, however, be used with some caution as a guide to the manuring of crops under ordinary conditions of farming. They are all extreme cases, drawn from the later years of the Rothamsted experiments, when the exhaustion of the available potash in the soil has become very pronounced through the continuous cropping with the help of a manure containing all the other elements of fertility except potash. Except on special soils, and with the specially potash-loving crops, it is not usual to find in this country that the use of a dressing of potash salts has any visible effect on the yield, so large is the stock of potash in the soil, and so well is it conserved by the ordinary systems of cropping. On the lighter soils, the sands and the gravels, potash is most likely to be deficient, and the ill-effects arising from its absence are intensified by the dryness of these soils. Even on such soils, potash manures will rarely be found remunerative for cereal crops; for mangels and potatoes, and to a less extent for turnips, they are necessary, while grass land can hardly be maintained in a satisfactory character without potash at regular intervals. On the stronger soils, potash is a remunerative manure for mangels, and occasionally for land laid up for hay, but in general, the use of nitrate of soda as a source of nitrogen will liberate enough of the locked-up potash in the soil for the needs of the crop. These points are well illustrated in the Rothamsted experiments on wheat, where there is a series of four plots receiving similar dressings of nitrogen and phosphates, in one case without any addition, in the others, with sulphate of soda, sulphate of potash, and sulphate of magnesia respectively. The source of nitrogen being ammonium salts no assistance in liberating the soil potash was to be derived from that source, consequently even in the first decade of the experiments the crop which was without any alkaline salt gave a lower crop than the rest. For thirty years, however, the sulphates of soda and magnesia were as effective as sulphate of potash itself, because each of these salts attacks the reserves of potash in the soil and brings some of it into solution. This process, however, had proceeded so far that, after thirty years' time, a full supply of potash from the crop was no longer obtainable from

the soil, and the yield with sulphate of soda or magnesia began to fall decidedly below that afforded by sulphate of potash itself. That the action of the soda and magnesia consists in liberating potash may be seen from the analyses of the crops grown; the use of magnesium sulphate, for example, as a manure does not materially increase the percentage of magnesia in the ash, but it does raise the proportion of potash.

a basic substance; the phosphate of lime contained in bones and similar compounds, the sulphate of lime in gypsum, are both ineffective, because they are neutral salts already saturated with a fixed acid; superphosphate of lime, being acid, even increases the draft on what is generally called the lime in the soil. Only basic slag, basic superphosphate, and nitrate of soda, among the artificial fertilisers, are independent of a

TABLE XXVI.—ROTHAMSTED WHEAT. Yield of grain per acre, 10-year averages; and constituents removed per acre in whole crop, average 40 years—1852-91.

Plot.	Manuring.	Yield of Grain.					Ash constituents removed per acre by crop		
		1852-61.	1862-71.	1872-81.	1882-91.	1892-1901.	Potash.	Soda.	Magnesia.
		Bush.	Bush.	Bush.	Bush.	Bush.	lb.	lb.	lb.
11	Ammonia and superphosphate only......	28·4	27·9	21·7	22·7	19·5	23·4	1·6	5·0
12	,, super., and sulph. soda	33·4	34·3	25·1	30·1	26·7	35·0	1·2	5·7
14	,, ,, and sulph. magnesia ..	33·5	34·4	26·4	31·1	25·0	36·8	0·8	6·4
13	,, ,, and sulph. potash	32·9	34·8	26·8	32·5	29·6	50·0	0·2	5·9
7	,, ,, and sulphates, potash, soda and magnesia	34·7	35·9	26·9	35·0	31·8	53·1	0·4	6·5

In the same way, it has already been shown that the omission of potash on the barley plots did not result in any diminution of yield for the first thirty years of the experiment, even when the nitrogenous manure was ammonia salts. The amount of potash contained in many of our soils is really enormous; for example, at Rothamsted the soil is a strong loam, approaching a clay, and it yields about 0·5 per cent. of potash when attacked by strong hydrochloric acid, but this is increased to more than 2 per cent. when the whole material is brought into solution with hydrofluoric acid. The true clays will be even richer in potash, and under cultivation a large proportion will become available by the action of weathering and of the carbon dioxide dissolved in the soil water. It may be concluded that on all except the lightest soils the requirements of the farm for potash manures will be met by an application of kainit for the mangel crop and an occasional dressing upon the grass land.

In the course of these lectures frequent mention has been made of the part played by the calcium carbonate, it should always be remembered that few of the artificial fertilisers can yield their full value unless there is a sufficiency of lime in the soil. It is not merely a compound of calcium that is necessary, but supply of calcium carbonate in the soil. The action of the soil calcium carbonate on the three constituents of fertilisers may be sumarised as follows:—Among the nitrogen compounds the presence of some free base is necessary to the nitrification of the ammonia compound which is formed with the clay in the soil, and if ammonia remains unchanged there is always loss of nitrogen by the action of fungi which seize upon the ammonia. Again, the decay of all the organic nitrogen compounds into forms available for the plant is chiefly brought about by bacteria, and it is necessary to maintain a neutral or very faintly alkaline reaction in the soil if these bacteria are to grow freely. The value of an application of lime in promoting the decay of organic nitrogen compounds is very strikingly seen on old pastures, gardens, or land which has been heavily manured for some time with organic manures. As regards the phosphatic manures, carbonate of lime in the soil is necessary to diminish the precipitation of phosphoric acid in the highly insoluble states of phosphates of iron and aluminium, compounds which are but slightly available for the plant. Calcium carbonate not only tends to decompose such compounds already present in the soil but prevents their formation in proportion to its own

abundance in the soil. Lastly, the presence of carbonate of lime not only liberates potash from its insoluble compounds already alluded to, but tends to prevent soluble potash salts applied as manure from passing into an unavailable condition.

How effective lime may be both in unlocking old reserves of manuring and in keeping fresh applications in an active condition may be seen from the following table, which shows the effect of 2,000 lbs. per acre of ground quick-lime applied to two of the Rothamsted grass plots in 1903 :—

TABLE XXVII.

LIME ON GRASS, ROTHAMSTED.

Year.	Plot 7.—Yield with mineral manures only.		Plot 9.—Yield with complete artificial manures.	
	Unlimed.	Limed.	Unlimed.	Limed.
	Cwt.	Cwt.	Cwt.	Cwt.
1903	49·5	51·9	50·1	60·5
1904	61·9	61·8	63·7	69·8
1905	44·3	47·2	36·9	52·2
1906	34·4	41·4	39·0	50·0

On plot 7 the lime has been used with phosphates and potash only; on plot 9 ammonia salts are also used, and the great increase of crop caused by the lime is doubtless also due to the oxidation of old nitrogenous residues of former crops, roots and stubble, accumulated in the surface soil.

In the short remaining time at my disposal I propose to touch briefly on one or two general questions connected with the use of artificial fertilisers. At the present time the annual consumption of all kinds amounts to about 1,250,000 tons per annum, whereas the area of land under crops and grass is about 47,670,000 acres in the United Kingdom, hence there is an average annual application of about ½ cwt. per acre over the cultivated area of the British Islands. A rough calculation, such as alone is possible, shows this total amount to contain about 43,000 tons of nitrogen, 152,000 tons of phosphoric acid, and over 5,000 tons of potash. The question for consideration is whether this average consumption can be profitably increased or not. It should not, however, be forgotten that among the methods of fertilising the land the consumption of imported feeding stuffs must also be taken into account; many farmers purchase little or no artificial manure, but by feeding extensively with purchased cake and corn they are constantly adding to the fertility of their holding. In 1905 the consumption of cattle foods in the United Kingdom was roughly as follows :—

		Million tons.
Maize, barley, peas, and other grain	..	3·5
Maize and other meals	..	0·5
Linseed, cotton, and other cakes ..	..	0·36
Linseed and other oil seeds ..	..	1·14
Offals, rice, meal, &c.	..	0·16

Making a total of 5·66 million tons.

Again, calculating approximately, in these food stuffs there are about 130,000 tons of nitrogen, 58,000 tons of phosphoric acid, and 45,000 tons of potash; about three times as much nitrogen, one-third as much phosphoric acid, and nine times as much potash as are contained in the fertilisers applied to the land in the same year. Before this material reaches the land about half of the nitrogen will have been either retained by the stock or wasted, but only about 10 per cent. need be deducted from the phosphoric acid and potash. Hence the imported fertility due to feeding stuffs is much greater than that due to fertilisers proper.

TABLE XXVIII.—CONSUMPTION OF MANURE AND FEEDING STUFFS IN THE UNITED KINGDOM.

	Tons.	Nitrogen.	Phosphoric acid.	Potash.
Manure	1,250,000	13,000	152,000	5,000
Feeding Stuffs	5,000,000	130,000	58,000	45,000

Of course there are no means of deciding to what extent these foods could be replaced by products grown at home by the aid of fertilisers, but the practical question often arises of how far it is profitable to fatten cattle merely with the object of making farmyard manure. There are many growers of valuable crops like hops or potatoes, consuming large quantities of manure, who fatten a lot of cattle or pigs every winter, not because any particular profit attaches to the live stock, but because they consider they need the dung the animals make. Unfortunately, farm book-keeping is rarely conducted in such a manner as will show the cost of such an operation, but I can put before you one case which gives the price of dung made in this fashion. In the yards 8 tons of cotton and 15 of linseed cake, 13½ qrs. of maize and 60 qrs. of oats, 69 tons of hay and 10 of mangels were fed to horses and fattening beasts; from this 460 tons of dung were made, and the average cost as it left the

yards was 6s. per ton. This cost was arrived at by charging the full price of the straw and the compensation values of the various foods consumed, which are based upon the composition of the feeding-stuffs and such as would be now allowed to the out-going tenant for food consumed during the last year of the tenancy. The 6s. per ton of dung is independent of any profit or loss attached to the sale of the fat live stock, it represents merely what the dung may be supposed to have cost. Even if the live stock repaid the cost of their initial cost, their food, attendance, and other incidental expenses, the dung would still have cost the farmer 6s. per ton. Only when a number of costs have been worked out in a similar way can the individual farmer ascertain whether it is possible for him to feed cattle at a profit in order to make dung; in my own opinion it is generally an unprofitable operation, and the farmer could get the required fertility more cheaply by the purchase of fertilisers, ploughing in an occasional green crop to maintain the humus and tilth of his soil.

The next question is whether the quantity of fertilisers employed by the British farmer can be profitably increased; can he obtain an adequate return if he increases his manure bill? Here it is necessary to take into account what is known as the law of diminishing returns. It has already been stated, for instance in treating of nitrogenous manures, that the yield increases *pari passu* with each addition of nitrogen. This is only partially true, holding for the first small additions of nitrogen, while there is still a deficiency of that element; later, however, the law of the minimum begins to operate, and the yield is limited by the amount of water available, or by some other factor which determines the extent of growth. The law of diminishing returns, which holds for many things besides manures, expresses the fact that the first addition of manure gives the largest increase, and that with each further addition there is a progressively lower increment to the yield; the falling off being little at first but growing rapidly, until at some point the increase ceases entirely, however much manure is put on. Some of the Rothamsted wheat plots illustrate this very clearly: there was a series of five plots all treated alike as regards the phosphates and potash, but which received respectively 0, 43, 86, 129, and 172 lbs. of nitrogen as ammonia salts. The following Table shows the yields:—

TABLE XXIX.—EXPERIMENTS ON WHEAT, BROADBALK FIELD.
Averages over 13 years (1852–1864).

Plot.	Manures per acre.	Dressed Grain.		Straw.		Returns.	
		Produce per acre.	Increase for each additional 43 lbs. N in manure.	Produce per acre.	Increase for each additional 43 lbs. N in manure.	Low prices. Grain, 24s. per qr. Straw, 20s. per ton.	High prices. Grain, 32s. per qr. Straw, 30s. per ton.
		Bushel.	Bushel.	Cwt.	Cwt.		
5	Minerals alone	18·3	—	16·6	—	72s.	98s.
6	ditto and 43 lbs. N as ammonia salts	28·6	10·3	27·1	10·5	113s.	155s.
7	ditto and 86 lbs. N as ammonia salts	37·1	8·5	38·1	11·0	149s.	206s.
8	ditto and 129 lbs. N as ammonia salts	39·0	1·9	42·7	4·6	160s.	220s.
16	ditto and 172 lbs. N as ammonia salts	39·5	0·5	46·6	3·9	165s.	228s.

The first addition of nitrogen produced an increase of 10·3 bushels of grain and 10·5 cwt. of straw, the second gave but little less, while the fourth addition of nitrogen only produced an increase of half a bushel of grain and 4 cwt. of straw. Clearly, if the grain and straw produced paid for the first addition of nitrogenous manure, it would not do so for the fourth addition, and the last half bushel of wheat and 4 cwt. of straw cost much more than it was worth. It is not therefore

certain that a farmer will make more profit by increasing his manure bill.

A further conclusion may also be drawn from the above table—the higher the prices the products fetch the greater the amount of manure that can be employed with profit, whereas, when prices fall, it becomes necessary to reduce the expenditure instead of increasing it to obtain a bigger crop. This may be made clear by a diagram showing the cost of growing the crops on each plot, taking a fixed figure of 80s. per acre as representing the rent and the cultivation, which is the same on all the plots, and adding 30s. for each increment of nitrogenous manure. Thus we get a straight line representing the increasing cost of production with each increase of manure. For the returns two similar curves may be plotted, one showing the values of the crops when prices are low—corn at 24s. per quarter and straw at 20s. per ton—and the other for corn at 32s. per quarter and straw at 30s. per ton. It will be then seen that with the lower prices the crops ceased to be profitable before the third addition of manure is made; the second addition was most profitable, for the extra 30s. expended on manure produced an increased return of 36s. in the crop. At the higher scale of prices the crop was profitable even with the highest amount of manure, but the third application only returned 14s., and the fourth only 8s. for the expenditure each time of 30s. for manure. Generalising from this instance we see the truth of the dictum of the late Sir John Lawes, that low prices cannot be met by high farming, but only by a reduction in the expenditure. Such arguments, however, which tend to show that a farmer may pay too dearly for an extra amount of manure on his land do not apply to the question of using the manure with greater skill. Small as the application of fertilisers is per acre in the British islands, anyone having much experience of farmers will know that a good deal of it is wasted, because it is used either for the wrong crops or on unsuitable soils. The special manurial requirements of our standard farm crops, and the adjustment of the various fertilisers to the chief types of soil have been already so far worked out that a great amount of the waste now going on might be at once avoided. Indeed, if the half hundredweight of artificial fertiliser that is now used per acre of cultivated land in the British Islands were only applied with due knowledge the increased profit would more than justify the purchase of double the amount of fertiliser. An increased manure bill must be accompanied by an increased knowledge on the part of the farmer, just as it is pretty certain that the great jump which has been seen in the consumption of phosphates during the last year or two represents one of the first fruits of the movement for agricultural education throughout the country which began some twelve years ago. What provision, however, is the country making for adding to the stock of knowledge at the service of the farmer? A start has indeed been made in the direction of education, but the necessary preliminary to education is research. The teacher can only hand on what is already known, and I shall have accomplished my purpose in these lectures very imperfectly if I have not made you realise how much there is yet unknown about the growth of our commonest crops and the action of our standard fertilisers. Only by continued investigation and experiment can a knowledge be obtained of the conditions necessary to make the maximum profit out of our land, our crops, and our stock. What provision then is the country making for research in agricultural matters? Well, I can only tell you that the grants of our Board of Agriculture for agricultural research during the past year amounted to £425, while the corresponding grant in the United States of America (salaries and administration expenses being excluded in either case) was more than £200,000. It is true that in both countries the local authorities also spend some money on agricultural experiments, but the same disproportion would probably be found between the respective amounts, if the figures could be arrived at.

Are we to take it then that these figures represent the relative importance of the agriculture of the two countries, or does the larger figure indicate the greater need of the American farmer for experiment and investigation? The exact contrary is the case; in the British Isles we have to farm with dear land, dear labour, and a number of charges due to the proximity of a high civilisation. Farming in consequence can only pay when there is a considerable monetary return per acre, and the bigger yield that is required involves intensive cultivation, the purchase of fertilisers and the employment of skill, to a degree, is needless to our competitors on a virgin soil. But each increase in the expenditure and skill necessary to obtain a crop means a greater opening for knowledge and investigation; science can do little to save money for the man who merely

stirs the surface of a virgin prairie, scattering in the seed meanwhile, and then leaves it to take its chance until harvest. Compare the highly technical routine of the hop grower who spends £50 per acre before he harvests his crop, his repeated cultivations, his manurings, his sprayings for various ends; it is with this kind of crop that science can find its most profitable employment.

Looking at the average yields of the various countries of the world we find that Great Britain is the most intensively farmed country; it obtains the biggest crops per acre, it has to spend the most to obtain them. Furthermore, the bigger the crop the greater are the risks of disease and blight, and the greater are the difficulties in securing high quality. Here then in Great Britain exists the greatest need for knowledge and investigation; nor can we always beg knowledge from wiser countries, for many of our problems are special and brought about by the very conditions of high farming which prevail here. England was the first country to start an experimental station, yet Rothamsted still remains the only institution solely devoted to agricultural research in the British Isles, if we except the farm of the Royal Agricultural Society at Woburn. The income of the Rothamsted Station, derived from private benefaction, is about £2,600 a year; in the United States each of the 53 States possesses a station receiving £3,000 a year from the Federal Government, in addition to what the State itself may contribute, while there is also the great Central Department of Agriculture, of which I have already spoken. Yet Rothamsted cannot obtain a grant from the Board of Agriculture to extend its operations; the country is too poor, agriculture too unimportant an industry.

I have wandered a little perhaps from the text of these lectures, but I have done so with a purpose; the use of artificial fertilisers is bound up with research, and Rothamsted has done so much for their investigation in the past that I may be pardoned in pleading for its consideration in the work that still remains to be done. And that consideration can only be secured by public opinion; in this country the Board of Agriculture is not expected to give a lead, but it will provide what public opinion may demand, hence I feel justified in asking for the support of a great learned body like the Society of Arts in the appeal we are making, not only for the needs of our own institution, but for agricultural research at large.

SEVENTH ORDINARY MEETING.

Wednesday, January 23, 1907; Sir JOHN WOLFE-BARRY, K.C.B., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Bancroft, Augustus Charles, J.P., F.S.I., Stokes-hall, Plantain-garden River P.O., Jamaica, British West Indies.

Cooper, Hon. Francis Alfred, C.M.G., M.Inst.C.E., Director of Public Works, Colombo, Ceylon.

Freehill, Colonel Francis Bede, M.A., Martin-place, Sydney, New South Wales, Australia.

Gordon, Walter, P.O. Box 96, Harrismith, Orange River Colony, South Africa.

Ikébé, Kichitaro, The Tokyo Asahi Shimbun, 4, Takiyama-cho, Kyobashi-ku, Tokyo, Japan.

Rich, William, Trevu, Camborne, Cornwall.

Smith, Milton W., 413, Failing-building, Portland, Oregon, U.S.A.

The following candidates were balloted for and duly elected members of the Society:—

Baltischwiler, E., Hotel Central, Zurich, Switzerland.

Chambers, Alexander George, 8, Khersonskaja, Onlitsa, St. Petersburg, Russia.

Hobsbaum, Isaac Berkwood, F.C.S., 79, Claremont-road, Forest-gate, E.

Ijuin, Admiral Goro, I.J.N., The Admiralty, Tokio, Japan.

Kerr, George A., Lynchburg, Virginia, U.S.A.

Newman, Arthur D., Messrs. Fraser and Chalmers, Limited, P.O. Box 619, Johannesburg, Transvaal, South Africa.

Trimmer, Lieut.-Col. Augustus Richard, Parkstone, Beckenham, Kent.

Walker, Captain Herbert Marriott, 228, Mackenzie-road, Beckenham, Kent.

Wyllie, Lieut.-Col. Sir William H. Curzon, K.C.I.E. M.V.O., 10, Onslow-square, S.W.

The paper read was—

THE PANAMA CANAL—THE "LOCK CANAL" TYPE AND THE "STRAITS OF PANAMA" TYPE.

By PHILIPPE BUNAU-VARILLA.

PART I.

THE SYSTEM OF CONSTRUCTION OF THE STRAITS.

When Charles V., in 1523, sent from Valladolid to Fernando Cortez the order to search out carefully on the east and west coasts of the New Spain the solution of the "Secret of the Straits" (*el Secreto del Estrecho*), he

opened up the great question which has been pending before humanity until our time. I hope to have the honour of making it evident to your minds: first, that this great secret is now discovered; secondly, that its principles were found about the year 1887, during the period when the old Panama Canal Company was at work; and thirdly, that science possessing henceforth all the solutions and all the practical elements necessary, the realization of veritable "Straits" between the Atlantic and the Pacific will take place, and that the work now being carried on by the Americans is only the preliminary phase of this great undertaking.

This secret that Fernando Cortez and his successors believed they would find in a line of fracture concealed between the two continental masses, resided in reality, not in the natural geography, but in the natural topography and hydraulics of the American Isthmus; not in disposition of its ground alone, but in the disposition of its waters and of its ground. Nature has certainly united the two continents together, but it has provided the connection with a hydraulic power such as it is only necessary to harness properly to allow it to displace the mass which obstructs the communication between the oceans, and to transport this mass into spaces which appear to be reserved and ready to receive it.

Definition of the "Straits."—Let us first give a few definitions so that our mind may be clear on this subject. What are we to understand by "Straits of Panama"? How does this new conception of the inter-oceanic water-way differ from the sea-level canal, the construction of which was undertaken in 1881 by Mr. de Lesseps, or from the sea-level canal as it was conceived by the American Government and the Isthmian Canal Commission, and submitted by that last body to the International Board of Consulting Engineers assembled in September 1905 by President Roosevelt at Washington?

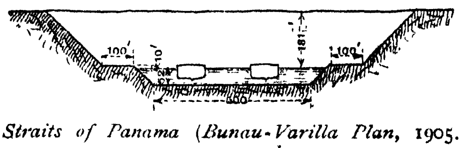
The sea-level canal of M. de Lesseps and that of the Isthmian Canal Commission were both canals with an invariable level, communicating freely with the Atlantic (the tides of which at Colon are insignificant—30 centimetres, or about 1 foot) and closed on the Pacific by locks. These locks prevent the Pacific tides (which attain 3 metres, or 10 feet) from penetrating into the canal, and from producing therein currents which might interfere with navigation. These two projects of a sea-level canal are similarly disposed in plan; the dimensions of their cross section only differ.

M. de Lesseps' sea-level canal had 9 metres (29½ feet) depth of water, 22 metres ($72\frac{1}{10}$ feet) width at the bottom, and 40 metres (131 feet) width at the water line.

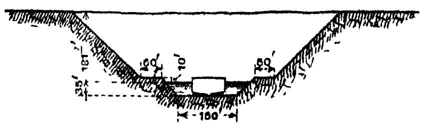
The sea-level canal of the Isthmian Canal Commission had 35 feet (10·67 metres) depth of water, 150 feet (45·75 metres) width at the bottom, and 220 feet (67·10 metres) width at the water line.

The water-way which I called the "Straits of Panama" when I submitted it to the Consulting Board in September 1905, is free of all locks. It communicates freely with the Atlantic and the Pacific. It is 500 feet (152·50 metres) wide at the bottom; 45 feet (13·75 metres) deep at the lowest tides, and its average breadth is 600 feet (183 metres) at the water line. It may be said, in round figures, that this new water-way would be three times broader and one-fourth deeper than the widest and deepest canal ever conceived across the Isthmus of Panama. It may also be said that its breadth, which is about equal to that of the Thames at London-bridge at low tide, is three times less than that of the Bosphorus at Hussein Pacha and at Kawak.

It is a water-way, the dimensions of which are exactly intermediary between those of a natural Straits like the Bosphorus and those of the widest artificial roads planned. It is a water-way of a width similar to those of the great navigable rivers. Strictly speaking one has the right to call such a water-way "Straits" as well as "Canal." (See explanatory note of Fig. J. in appendix, page 273.)



Straits of Panama (Bunau-Varilla Plan, 1905.)



Sea Level Canal (Isthmian Commission's Plan, 1905.)

FIG. J.—COMPARATIVE CROSS SECTIONS.

I selected the first appellation in order to characterise the suppression of all artificial work, such as tide locks, with which the plans of the Panama sea-level canals have always been encumbered, and in order also to charac-

terise the absolute liberty of navigation and of crossing which the ships will enjoy. Because of the great width and of the great depth given to the "Straits of Panama," it deserves an appellation which recalls the natural not the artificial navigable channels.

Tidal Currents and Currents of Fluvial Water in the "Straits of Panama."—At the simple announcement of a free inter-oceanic communication a preliminary question rises in all minds. Is it possible? Is there not a difference of level between the oceans which makes irrealisable such an open communication? My immediate reply is: No, there is no appreciable difference between the average level of the two oceans, but, as I have already said, the Pacific at Panama has tides which make it rise 3 metres (10 feet) and cause it to descend 3 metres below the average level. On the other hand, the Atlantic at Colon has no tides worth mentioning. Variations of level from 30 centimetres (1 foot) above or below the average level—that is all that has been observed. This being laid down another question arises which has often been answered carelessly in the negative. Will not the periodical variations of level of the Pacific cause currents in the canal incompatible with navigation?

The same question was raised about Suez a long time ago. The Red Sea at Suez has tides like the Pacific, but about one-third the amplitude of the Pacific tides. At a distance from the Red Sea equal to about also one-third of the distance between the Pacific and the Atlantic is a vast surface of water—the Bitter Lakes. They have an almost invariable level like the Atlantic. On the Suez Canal, therefore, the same conditions which are found at Panama are reproduced on a scale of one-third.

In 1856, Lieussou, a member of the Naval Hydrographic Engineers Corps of France, calculated that the maximum of the flood current between the Red Sea and the Bitter Lakes would be 1·16 metre per second and the maximum of the ebb current would be 0·97 metre per second. This calculation, formulated thirteen years before the inauguration of the Suez Canal, was almost rigorously confirmed by experience. After many years it was established that the maximum flood current was 1·20 metre per second, and the maximum ebb current, was 1·1 metre per second. Between theory and experience there was, therefore, only a difference of eight hundredths of one knot for the flood and twenty-five hundredths of one knot for the ebb currents. This proves what degree of confidence we may have in such calculations.

The slope between the Atlantic and the Pacific at high or low tide being about the same as between the Bitter Lakes and the Red Sea at high or low tide, the tidal currents must be about the same in the two cases. A Commission of the Academy of Sciences of France calculated these currents for Panama. (Report of the Academy, May 31, 1887.) The maximum calculated for the current was 1·17 metre per second, that is 2·27 knots an hour, and this with an exceptional tide of 6·76 metres of amplitude, which can only occur once a year. This current was calculated for a canal with restricted dimensions (about equal to those of the De Lesseps canal), 9 metres in depth (29 feet) at Colon and 11·50 metres ($37\frac{7}{10}$ feet) at Panama, and 21 metres ($69\frac{15}{100}$ feet) in width at the bottom.

If the climate of Panama were as perfectly dry as that of Suez, there would not be a shadow of justification for not admitting for Panama the solution that succeeded so admirably at Suez. The conditions of the fluvial waters is the reason to be invoked as an explanation of the rejection of the free opening with a narrow canal. The only complete solution of the management of fluvial waters of the rainy Isthmus of Panama leads us to admit a direct flowing into the canal of a volume of about 800 cubic metres per second, in case of exceptional swellings of the rivers. Even if we suppose that one-half shall flow into the Atlantic and the other into the Pacific, that would generate an additional current of nearly two knots in the sea-level canal projected by the Isthmian Canal Commission and still more of course in the narrower de Lesseps Canal.

In a canal as narrow and as shallow as the so-called sea-level canal, currents superior to two and a half knots would be inadmissible; we are, therefore, naturally led to increase the section in order to free the vessels from the objectionable action of the cumulated tidal and fluvial currents. Naturally the tidal currents will increase a little with the width and depth of the water-way, but the fluvial currents will decrease much more quickly, exactly in inverse proportion to the wet section of the navigable highway.

If we make again the calculations of the Academy of Sciences and apply them to the dimensions I have quoted above for the "Straits of Panama," we find that for the usual maximum tide of 6 metres of amplitude, the maximum current will be 2·93 knots. As

the wet section will be about six times greater than in the sea-level canal of the Isthmian Canal Commission, the flowing into it of 400 cubic metres a second will not produce more than a current of 0·3 knot. We may say then that the maximum current to which vessels will be exposed will not reach 3·3 knots, an absolutely insignificant velocity considering the width of 500 feet (152·50 metres) at the bottom, and the depth varying from 45 feet (13·72 metres) to 65 feet (19·82 metres).

The exceptional tide of the Academy of Sciences, which can only occur once a year, in September, would bring about a maximum velocity of 3·14 knots. If, by an extraordinary coincidence, it should meet with one of these exceptional floods, which requires the flowing during several hours of 400 cubic metres, we should not attain 3 knots and a half. This would probably not occur once in a century and would only last a few hours. We may, therefore, say that the real maximum current will be 3·3 knots.

We see, then, that the precedent of Suez guarantees the certain success of such an undertaking, as far as the currents are concerned. But even without this precedent we should have a right to rely on it implicitly, for I repeat that the "Straits of Panama" will have the dimensions of a very large navigable river, like the Thames or the Seine, flowing like them into a sea that has tides of 6 metres of amplitude. There cannot therefore be currents in the "Straits of Panama" more inconvenient to navigation than those of the Seine or the Thames.

As the maximum currents will occur in the neighbourhood of the Pacific (5 lunar hours after low tide), the question may be asked whether the soil of this region is consistent with the velocity of the water.

On this point there is no reason for alarm; the subsoil through which the bottom of the bed of the Straits will be dug is compact and resisting everywhere. It will be only necessary on the last eight kilometres on the Pacific side to protect the sides of the canal with stone embankments, the upper strata of the soil being soft there. This is an easy as well as inexpensive matter.

It results that no objection can be raised with regard to navigation, against the creation of the "Straits of Panama," that indispensable artery of the commerce of the world, the only route permitting a rapid and free passage in four or five hours, the only form of water-way free from all artificial work, locks or dams, the only one protected from accidents, explosions, destruction (in case of war), or earthquakes.

The Indispensable Tool for the Realisation of the "Straits of Panama"—the Dredge.—It is not sufficient to define the ideal type of communication between the oceans; it must also be practically realisable. Now, with the means generally employed, with those used by the Company presided over by M. de Lesseps during almost the entire duration of its existence, with those employed by the second Panama Company, the new Company, with those that the American Government is employing at the present day, such a conception is radically chimerical.

In the three cases quoted above the organ of excavation is the excavator or steam shovel, rolling on rails; the organ of transportation and dumping of the spoils is the car, rolling on rails. With this method, the method in the dry, the difficulties caused by the diluvian rain, in the preservation of the railroad tracks, are enormous. It is necessary for a relatively feeble production to have a considerable number of workmen in constant attendance. Accidents and running off the rails occur incessantly, because in a vast excavation work the tracks often have to be shifted to follow the terraces. Consequently they can neither be well fixed, nor well ballasted, nor well drained.

These necessities, combined with the brusque and violent tropical rain, the bad quality of the workmanship in that country where depression and fever are rife, and the clayish and slippery nature of the soil of the Isthmus, end in runnings off the rail, in accidents which occur over and over again, and which are the great, the only and the essential difficulty of the excavation of the Panama Canal.

The estimates prepared by the Isthmian Canal Commission, the American official authority entrusted with the execution of the Panama Canal gave, in September 1905, as the cost of the sea-level canal excavated in the dry, the following figure:—321,779,731 dollars, that is £64,355,946 sterling. This valuation comprised 7,000,000 dollars for the tidal locks, and 10,394,794 dollars for the masonry walls at Culebra, an erroneous conception now entirely abandoned.

We may, therefore, say that by overlooking these two elements of the work, the estimated cost of digging a lockless sea-level canal, 35 feet deep and 150 feet wide, was, in 1905, in round figures, 300,000,000 dollars, that is

£60,000,000. These figures were arrived at by the official American Commission after six years of study, and two years of effective work under its own management in the Isthmus.

The length of time for the execution of this canal was estimated at more than twenty years by the Commission in 1901, and in 1905 one may conclude from the documents of the Commission that it allowed twenty-two years. The volume of the excavations to be extracted for the sea-level canal thus conceived, having 35 feet depth below mean level from the origin on the Atlantic to Miraflores, K. 62, and 45 feet depth below mean level from Miraflores to the Pacific end, K. 75, with 150 feet bottom width, lateral slopes of 45° and bermes of 50 feet on each side of the canal at 10 feet above the water, is 205,000,000 cubic yards (156,000,000 cubic metres).

The volume of the navigable highway that I have called the "Straits of Panama," with an average depth of 50 feet below mean tide (45 at Colon, 55 at Panama), the width at the bottom being 500 feet, slopes at 45°, and bermes of 100 feet on each side, is about 600,000,000 cubic yards (457,000,000 cubic metres). The completion of the "Straits" would necessitate, roughly speaking, an outlay three times greater than that of the sea-level canal. According to the Isthmian Canal Commission's own figures, it would be necessary to spend 900,000,000 dollars, that is £180,000,000 sterling, or 4,500,000,000 francs, and to wait about 60 to 70 years to see the first vessel pass through it.

Such figures explain sufficiently why the rational and complete solution of the Panama problem. the opening of a water-way unobstructed by locks, having free openings on the two oceans, sufficiently wide to allow ships to navigate and to pass each other without being inconvenienced by the tidal and fluvial currents, has never been examined or discussed before September, 1905, when I submitted it to the International Consulting Board which met at Washington.

If I acted thus, it was not for the vain satisfaction of fixing a theoretical and chimerical term to the efforts of the engineers. In showing them the enviable and desirable end, I showed at the same time the practical way to reach it.

Since 1879, when the first International Congress was assembled by M. de Lesseps, until 1905, when the last one was assembled by Mr. Roosevelt, all the numerous Commissions by whom the Panama Canal was discussed, have all, without exception, forgotten one thing. This was the most important, the essential question—the mode of execution.

All these Commissions have admitted as implicit truth, as an axiom, that the Panama Canal would be excavated in the dry. They then discussed the maximum and minimum form compatible with this mode of execution from the narrow level canal closed by tidal locks on the Pacific side to the lock canal with a summit level, more or less high, in the centre of the Isthmus. (See Fig. K., p. 244.)

Now this particular mode of execution is not the only one as the various Commissions have thought. The excavation, transportation, and dumping may be effected in the dry, on rails, but it may also be effected on water. The excavation in the dry is not the only mode of excavating—it is also the worse, the more expensive and the poorer one. The defects which exist in temperate regions increase in incredible proportions under the climatological conditions of the Panama Isthmus.

With the excavation by floating dredges, transportation by barges and dumping in deep water, all the Isthmian difficulties vanish as if they had been touched by a magician's hand. (See Fig. M., p. 245.)

There is no more need of an enormous army of workmen, changing every minute some of the tracks, in order to follow the progress of the earthwork. There is no more need for the ceaseless care to be taken with the moveable tracks, which have necessarily poor foundations and cannot be disposed for supporting any heavy traffic. There is no more need for struggling against the sudden tropical floods which bring down on the tracks the mud torn up from the slopes of the cut, submerge them, ruin their foundations or bury them. There is no more need of stopping series of steam-shovels for the frequent runnings off the rails, which these unavoidable conditions of the soil and climate bring about constantly, blocking for whole days communication between the points of loading and points of unloading. There is no more need to struggle against the landslips which stop the excavation work, and when they take place on the lines of communication paralyze, by repercussion, both a considerable plant and a great number of hands. There is no more need to tax one's ingenuity to enable the trains to circulate over the dumping places where the rain causes frequent landslips. There is no more need for hesitation between this Scylla and that Charybdis, which is, either to have heavy trucks and powerful locomo-

Fig K.—Works in the Dry (Culebra in 1888). (See Appendix, p. 273)

FIG M—WORKS IN THE WET (DREDGE WORKING IN BLASTED ROCK—1888) (See Appendix, p 273.)

tives for excavating huge masses of earth which demands the heavy penalty of more frequent runnings off the rails, so difficult to keep in order, or to have lighter plant circulating more easily, but less powerful and carrying away insufficient masses. There will be no more need of exposing to the alternative sun and rain thousands of workmen who are struggling against nature, and consequently of enduring the sorrowful procession of fevers, and pneumonia which result from this inhuman work.

With the excavation on water by dredges, transportation on water by barges, and dumping into deep water by opening traps at the bottom of the barges, all these difficulties vanish. The carriage power of water is unlimited, and the most powerful organs for excavation may be employed without any drawback. As a matter of fact, dredges with buckets of 1 cubic yard (764 litres), are at present in current use. As there are 15 passing per minute they are capable of bringing up from the bottom more than 22,000 cubic yards in a day of 24 hours.

Making a very liberal allowance for stoppages and other causes of diminution of work, the most pessimistic of dredgers would not figure for one of these instruments on an effective yielding of less than 7,000 cubic yards (5,348 m.c.) measured in the excavation. And dredges of this capacity are not the most powerful ones. There are some in Great Britain which have buckets of about 2 cubic yards (1,528 litres), that is, which can give a useful and practical yield of 14,000 cubic yards (10,700 m.c.) per day, in the most unfavourable circumstances.

With the transport by water a barge can easily carry 2,000 tons of material, that is about 1,000 cubic yards of the heaviest ground (764 m.c.) measured in the excavation, and even more. The number of hands on board a dredge doing this enormous work would be fifteen men if it is a steam dredge, and ten men if it is worked by electricity. On board a barge there would be two or three. The dumping is automatic, and only requires the action of gravity.

All these men live on board the dredge and the barges, protected from the sun and the rain, their only work being to control and watch the machinery—that is, a work without any physical effort. The number of hands is very small; the men are absolutely protected against the inclemency of the weather, just as the plant is itself quite indifferent to rain or sun, night or day.

This admirable and complete solution of all the Isthmian difficulties is reflected naturally in the cost price. I will only mention the figures contained in the report of the International Consulting Board as the result of its inquiries of 1905.

In Appendix K. of the report we find that the excavation, in the dry, of earth and soft rock at Culebra cost for desagregation $11\frac{25}{100}$ cents, that is, $5\frac{5}{8}$d., or $56\frac{25}{100}$ centimes, and that the excavation, transportation, and dumping in the dry cost $60\frac{16}{100}$ cents, or 2s. $5\frac{8}{100}$d., or 3·038 francs, per cubic yard (0·764 m.c.).

In Appendix I. of the same report we find that the excavation by dredge, transportation, and dumping in the sea costs 7 cents, or $3\frac{1}{2}$d., or 35 centimes at Colon, and 8 cents, that is 4d., or 40 centimes, at Panama, per cubic yard (0·764 m.c.) The difference between these two latter prices of 7 and 8 cents. is accounted for by a longer transport in the second case.

It must be noted that the excavation in the dry was made with a new plant bought by the American administration, and that the excavation in the wet was made with the old plant from the first Panama company which had been out of use for 16 years. If the dredges and barges used had been of the power now usual, the prices would have been incontestably about one-half less and reduced, per cubic yard, to 3·75 cents, or $1\frac{7}{8}$d., or 0·185 francs. Mr. Welcker, the Dutch delegate on the International Consulting Board, remarked, in fact, as we see in the Appendix J, that the cost in Holland was 5 cents, or $2\frac{1}{2}$d., or 0·25 francs per cubic metre, including cost of transportation, to 6 or 7 kilometres (4 miles to $4\frac{1}{2}$ miles). This corresponds to 3·75 cents per cubic yard, the price we just named for actual dredging by large steam bucket dredges on a great scale.

Thus we see that the cost price of effective and real works, both in the dry and in the wet, reached by the International Consulting Board, establish a proportion of 1 to 16 between the cost of the excavation work, transport and dumping in the dry on rail and that effected on water in the Panama Isthmus. This enormous disproportion is entirely in harmony with what must be expected from two systems, one of which antagonises all natural forces while the other utilises them.

Gratuitous Electric Power.—But that is not all. The establishment of the dredges, water transport, and dumping is connected,

as I will show further on, with the establishment of a dam at Gamboa, across the Chagres, the large river that follows the canal for 27½ miles (44 kilometres) on the Atlantic side. The falls of this dam, erected across the river a little above the point where it enters into the line of the canal, will correspond to a minimum of about 32,000 horse-power, permitting of the free distribution of power to the dredges, barges and instruments for breaking the rock which, by the way, is generally very soft. This electrification of the whole of the great working ground would again allow of an important reduction in the already small cost of dredging and of the transportation of the spoil by water.

Rock-dredging.—The following question might be asked:—However great may be the economy in the excavation of the loose ground by the dredge, is not the removal of the submerged rocks an insurmountable obstacle? We now touch on one of the technical questions ignored singularly enough even by engineers reputed as skilled and competent.

Twenty-five years ago, when I was at the Ecole des Ponts et Chaussées (school for engineers of the government of France), we were taught that this was an operation costing 30 to 35 francs per cubic metre, £1 sterling per cubic yard (1 cubic yard equal 0·764 cubic metre). More recently still we saw the Isthmian Canal Commission including dogmatically (Report of November 16th, 1901) in its list of standard prices, that the extraction of rock under water would cost 4 dollars 75 cents a cubic yard (19 shillings or 23·75 francs). Such exorbitant prices still dwell in the brains of many engineers. In 1885 at Colon, being obliged to remove some submerged rock, I mined it by a process which reduced it to pieces as large as pavement stones and I dredged it afterwards. The dredge did not seem to make any difference between such perfectly broken rock or ordinary sand. This cost me, in spite of the rudimentary method of mining employed, about eight francs per cubic metre, or six francs a cubic yard, that is one-fourth of the price which the Isthmian Commission, composed of the most eminent American engineers, approved sixteen years later; and yet, since my work of 1885, there has been great progress made. Lobnitz, the eminent dredge builder of Renfrew, invented 18 years ago the *derocheuse* (rock destroyer) for the Suez Canal. It consists in a heavy steel chisel ending in a moveable point, which reduces the hardest rocks into pieces the size of a man's head. The heavier the chisel the greater the amount of work accomplished and the less the cost per cubic yard. The weight of the chisel has gradually increased from four to twenty tons. It will certainly reach fifty tons, and then the price of the breaking of rock will be insignificant. Even at the present day the crushing of rocks of average hardness is less than one shilling per cubic yard.

In *Engineering*, August 17th, 1906, there is a note given by Mr. Hunter, chief engineer of the Manchester Ship Canal, stating that the price of crushing rock in the ship canal during ten months work, was less than 9d. per cubic yard, and that in spite of the loss of time due to the passing of vessels. The minimum quantity of work per month was 5,622 cubic yards (4,294 m.c.), the maximum quantity, 10,180 cubic yards (7,778 m.c.), the average quantity, 6,403 cubic yards (4,892 m.c.). The minimum was therefore 225 cubic yards per day. (See Fig. I., p. 248.)

M. Quellennec, Consulting Engineer of the Suez Canal and Member of the Consulting Board, handed over to that body a memorandum stating that the price of crushing rock at Suez was 25 cents per cubic yard by the same Lobnitz method. By one of the most singular and inexplicable omissions, this very important document has never been inserted in the Consulting Board's report, nor in any of the annexes. Neither has any mention been made of the data that Mr. Hunter must have furnished also as a member of the Consulting Board, on the results obtained in the Manchester Canal, later published in *Engineering*, and which are in absolute conformity with those obtained at Suez. These economical results were obtained with chisels of 12 tons at Manchester and 15 tons at Suez.

Comparing the Culebra rock with that of the Manchester Canal, we find that, except in the case of a few dikes, it is infinitely softer than the sandstone of the Manchester Canal. The Manchester price is, therefore, a maximum, and there is no doubt in my mind but that the price of crushing would fall below 11 cents, the present price of mining with explosives in the dry—even if the Lobnitz chisels were worked by steam. The free use of electricity from the Chagres Falls at Gamboa, and the increase of weight in the chisels from 15 to 40 or 50 tons would certainly reduce the crushing to a few pence, surely to less than half the cost registered at Manchester.

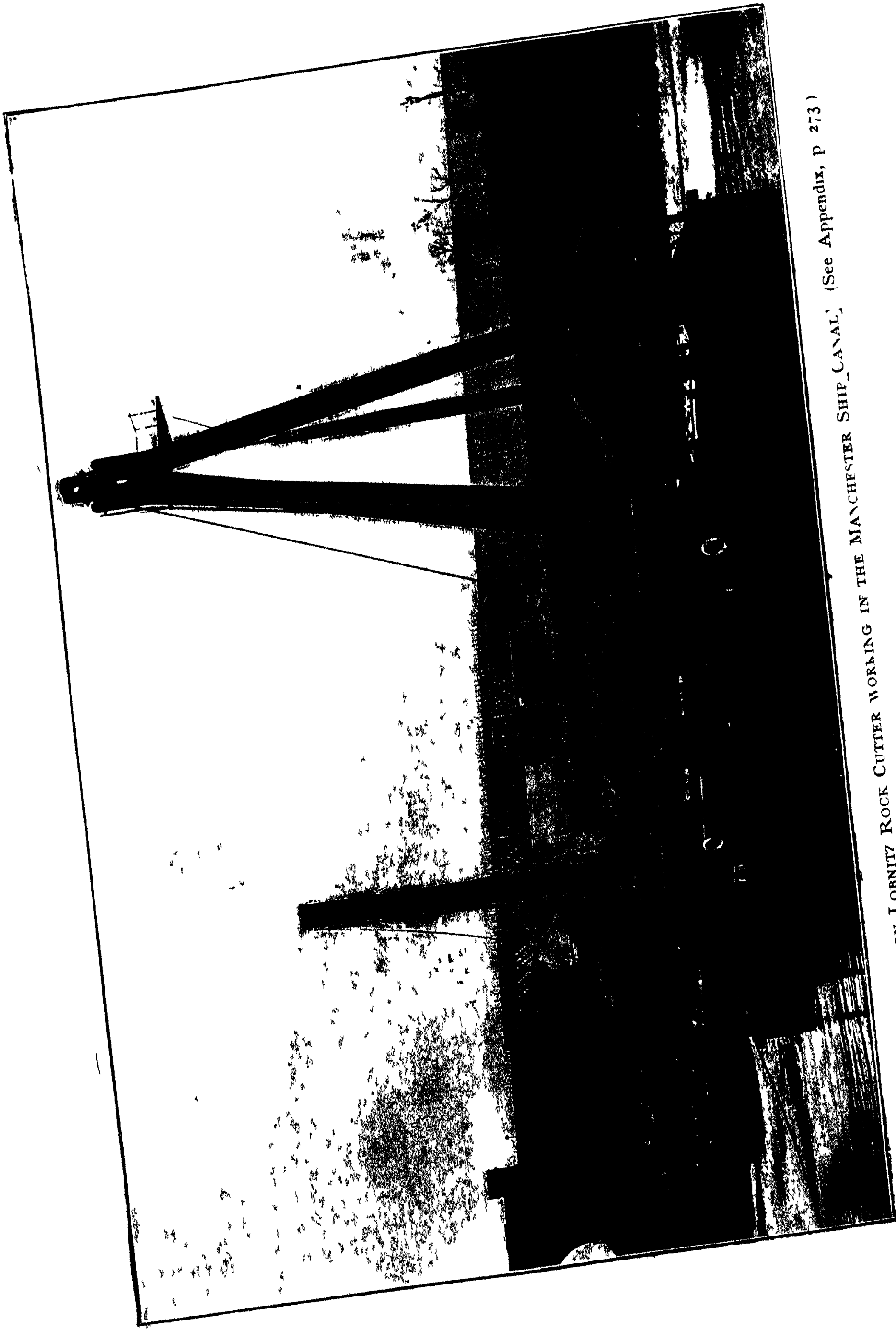


Fig. 1.—Twelve ton Lobnitz Rock Cutter working in the Manchester Ship Canal. (See Appendix, p. 273.)

Why did the Consulting Board not insert the memorandum of M. Quellennec, the Consulting Engineer of the Suez Canal, on the real cost price of the crushing of rock at Suez? Why was no mention made in that report of the information that Mr. Hunter, Chief Engineer of the Manchester Canal, must have supplied? There is, in Appendix I. (p. 273), proof that this important information had been given to the Board.

Mr. Wallace, the first engineer in chief of the Panama Canal, appointed by the American Government, said (see p. 380 of the Report) :—

"As regards the excavation of submerged rock there is a process which has not been mentioned in any of these reports, but I think that M. Bunau-Varilla has spoken of it; it is the breaking of the rock by what is termed chisel-work.

Mr. Hunter:—You mean the Lobnitz system?

Mr. Wallace:—I do not know what you call it.

Mr. Hunter:—It is perhaps not necessary to dwell on that subject. We have discussed it at length here. It is a proceeding with which M. Quellennec and myself happen to be both extremely familiar."

The silence of the Board in this report on the facts that the two eminent engineers of the Manchester and Suez Canals must have supplied, is all the more suspicious as the price adopted by it for the excavation of submerged rock is 2½ dols., that is ten shillings, or 12·50 francs, per cubic yard; whereas according to the figures for the crushing given by the English delegate, Mr. Hunter, in the *Engineering*, the maximum price of rock breaking ought to have been 18 cents American money), and the price of subsequent dredging ought to have been the one supplied by the Dutch delegate, Mr. Welcker, 3¾ cents (American money). The price of the removal of rock under water ought then to have been fixed by the Board not at 10s. a cubic yard, but at 10⅞d., that is to say, at a price more than ten times smaller. And even such a low price ought to have been considered as a maximum on account of the economy that will arise from the use of the free electric energy from the Gamboa lake, for supplying motor power to the dredges, to the Lobnitz rock crushers, and to the barges used for transport. It could, therefore, be expected to be brought down to 7½ pence per cubic yard in the average Culebra rock. The Consulting Board preferred to this logical and experimental price the arbitrary one of 10 shillings.

We may now sum up this exposition of the advantages of the method of dredging substituted for the method in the dry, by saying that it is 16 times more economical when the ground does not necessitate preliminary desagregation. If the ground necessitates such preparation, the crushing by the Lobnitz process, in the wet method, costs less than mining in the open air by the dry method. Such is the scientific truth which results from the experience of great hydraulic undertakings pursued at Suez, Manchester, and a number of other places. I do not hesitate to say that this figure of 11 cents, or fivepence halfpenny, or 0·55 francs, which I consider a maximum for the desagregation of the Culebra rock by heavy chisels of 40 to 50 tons, worked by electricity, and which may appear bold, will appear less so when we consider that the Japanese at Okasaki and at Yokohama, in a soft rock just like that of Culebra, with small Lobnitz chisels worked by steam, spent about four times less per cubic yard.

In the account I gave in September, 1905, before the Consulting Board, of the "Straits of Panama," I did not want to go to the extreme with regard to the advantages of the system of excavation by water, and I limited myself to asking that it should be admitted that it was three times more powerful, and three times more economical on an average, than work in the dry, whilst it really is 16 times more so in a loose soil, and 4 times more so in a rocky soil. I thought that this extreme moderation would permit of an easier approval of my proposal. This humble proposition sufficed, in any case, to prove that it would not cost more money or more time to make the "Straits of Panama" by dredging, than to make the narrow sea-level canal closed by tidal locks with excavators in the dry. But this moderation on my part did not disarm the incoercible partisans of the working in the dry. The system was rejected by the Consulting Board. They could not be convinced either by the grandeur of the end that could be reached or by the evidence of figures collected by the Board itself as to the cheapness, practicability and power of the new method.

Erroneous Arguments Invoked for Rejecting the Dredging Method without which the "Straits of Panama" are Chimerical.—The Consulting Board was content to pass over in silence the eloquent figures relating to the extraction of the rock under water in the Manchester and Suez Canals, and adopted a unit price ten times higher than that resulting

from these experiences. This allowed the Board to condemn the method proposed.

This is what we find on page 32 of the report of the majority of the Consulting Board, signed by Messrs. Geo. W. Davis, W. Barclay Parsons, and Wm. H. Burr, Delegates of the American Government; Mr. Henry Hunter, Delegate of the English Government; Eugen Tincauzer, Delegate of the German Government; and J. W. Welcker, Delegate of the Dutch Government and Kellennec, Chief Engineer of the Suez Canal:—

"The claim made by M. Bunau-Varilla that the excavation can be done at low cost rests mainly on the expectation that by the use of electric power, developed at the Gamboa dam and distributed along the line, the expense for fuel for generating steam will be eliminated, and the cost of all mechanical operations reduced by what appears to the Board to be a much exaggerated estimate of the economies thus affected, and on the further expectation that excavation can be made at very much less cost by dredging than in the dry. This reduced cost of dredging is probably true for sand, clay, and other materials that can be moved without being shattered by some preliminary process, but nearly all the materials to be dredged for the transformation are classified in the Board's estimates as rock, and will have to be loosened by blasting under water, by breaking or pulverising—as in the Lobnitz method—or by such other methods as may be devised. Moreover, it must be remembered that the greater part of the dredging is to be done under 40 to 50 feet of water, which will add much to the cost. The unit prices adopted by the Board represent its best judgment in regard to the cost of excavating the several classes of materials which the transformation would require, with the best methods and appliances now in use."

It is hardly necessary to point out the fundamental errors which this paragraph contains:—1. In a dredge where the motive power is free, it is of no importance whatever whether dredging takes place at 20 or 50 feet. 2. It is absolutely false to state that almost all the material to be excavated is rock. The Isthmian Commission admitted that there was about one quarter soft rock, one quarter hard rock, one half earth in the canal (outside of the maritime sections)—that is, from kilometre 24 to kilometre 62. The person who drew up this part of the report evidently considered it necessary to make this assertion, which is so contrary to all material facts, in order to increase the importance of the illusory objections drawn from the false price of excavating rock under water. This erroneous assertion harmonises with the adoption of the ten times too high and prohibitive price of 2·50 dollars for rock excavation, and with the suppression of the information of Messrs. Quellennec and Hunter regarding the veritable prices established at Suez and Manchester. Thus, the necessary system of the substitution of the dredge for the steam-shovel was condemned in 1905 for this imaginary reason: "The ground is too hard."

The first Commission formed after the failure of the old company had also come to the same conclusions, and in 1890 had condemned the dredging system that I had installed in the centre of the Isthmus on both sides of the higher part of the Culebra cut. I had, in fact, inaugurated the dredging of the Culebra cut at the end of 1888, but the dredging work was interrupted in its commencement by the financial crisis, which paralysed the completion of the canal. The Commission, consisting of well-known technical authorities, in 1890, also condemned this method, but this time it was for a contrary reason to that which in 1905 was brought forward by the Consulting Board.

"The idea of turning the principal enemy—water—into an auxiliary is certainly ingenious," said the Commission of 1890, "but it is impossible, the ground is too soft. Perhaps the idea may be taken up later when the harder ground below is reached." Reasons are never wanting to a judge who is anxious to condemn.

Is it also necessary, in order to show the nature of the objections raised by the Consulting Board, to call attention to the fact that, in their report they have inverted the two factors of the economy that the system which I proposed will realise.

The report represents the employment of the free electric power from the falls of the Gamboa lake as the principal element from which I expect to derive economy, while in reality it is only the secondary element. It presents further as a subordinate element what I presented as the keystone of the system of construction, its principal and essential element: the substitution of work on the water for work in the dry. The "Straits of Panama" cannot be made except by dredging, but whether the electricity is free or not means simply the difference between the cost of 24,000 horse-power during ten years generated at a steam central station, and the cost of harnessing waterfalls giving 48,000 horse-power.

Admirable Conditions Presented by Nature for the Employment of the System of Excavation on Water.—After having shown the natural privilege of the dredging method, to the brilliant qualities of which

its enemies have not been able to oppose anything but an illogical and baseless condemnation, I will now show with what marvellous perfection it can be adapted to the present conditions of the Isthmus.

If we cast a glance over the profile in length of the natural ground we find three quite distinct zones:—(See Fig. B. or D. or E. in the Supplement and Explanatory note in Appendix, pp. 270-272.)

1. The central mass extending from K. 46 to K. 57 (mile 28·38 to mile 35·42).

2. The high valleys of the Chagres and of the Rio Grande, K. 24 to K. 46 (mile 14·90 to mile 28·58) on the Atlantic side, and K. 57 to K. 62 (mile 35·42 to mile 38 53) on the Pacific side.

Lastly, the low valleys, the maritime sections of the two rivers, the parts where the bottom of their bed is below the average level of the sea. They extend, on the Atlantic side, from K. 0 to K. 24 (mile 0 to mile 14·90), and on the Pacific side from K. 62 to K. 75 (mile 38·53 to mile 46·62).

The elevatlon of the ground on the axis is on an average on the total length (75 kilometres or 46·62 miles) 14 metres 55 ($47\frac{7}{10}$ feet) above the average level of the oceans, but this altitude of the ground varies considerably in the three natural groups that I have mentioned.

In the central mass the average elevation is 181·7 feet (55·43 metres); the maximum elevation of the ground on the axis is 333 feet (101·66 metres), it is 149·4 feet (47·57 metres) at the beginning of the section K. 46, and 110·7 feet (33·78 metres) at the end of this section K. 57.

Between the maritime part, Atlantic side, and the central mass, that is to say between K. 24 and K. 46, the average altitude is not more than 47·9 feet (14·65 metres). In the corresponding section, that is from K. 57 to K. 62, on the Pacific side, the average altitude is 53·3 feet (16·25 metres). Lastly, in the maritime parts the average altitude falls to 11·9 feet (3·68 metres), on the Atlantic side from K. 0 to K. 24, while on the Pacific side it falls below the average level of the sea and is only −2·3 feet (−0·69 metre).

This glance at the configuration of the Isthmus shows that the heaviest part of the excavation work will have to be done over the 11 kilometres extending between K. 46 and K. 57. In fact, out of the volume of about 205,000,000 cubic yards which would have to be excavated over the 75 kilometres of the canal in order to obtain the sea-level canal of the Isthmian Commission (Project of 1905: 35 feet in depth, 150 feet in width at the bottom, and 50 feet berme), there is not less than 114,000,000 cubic yards or 87,000,000 cubic metres to be extracted from the central mass on the 11 kilometres length. Thus we have more than half the total work concentrated there.

Almost the same may be said in regard to the "Straits of Panama," with its 500 feet of width, its average depth of 50 feet, and its bermes of 100 feet. The straits necessitate an excavation of 600,000 cubic yards (458,000,000 cubic metres). Of this amount 260,000,000 cubic yards (199,000,000 cubic metres) must be excavated from the 11 kilometres of the central mass. In this case it is not quite the half of the total excavation, but about four-ninths.

The Gamboa Lake and its part in the Excavation of the Straits.—If we glance at the map of the Isthmus we shall see that the Chagres, the principal river of the Isthmus, enters the line of the canal at K. 45 (27·96 miles). (See Fig. C, p. 252.) Just above this point the river passes between two mountains, the Cerro Obispo and the Cerro Santo Cruz, both formed by a hard and homogenous pudding stone. The rocky slopes of the two mountains meet under the bed of the Chagres, about eleven metres lower than this bed, or in other words, at the sea level. The whole, when cleared of sediment and soft rock, forms a sort of V about 500 feet (150 metres) wide at the bottom, and with an opening of about 2,250 feet or 675 metres at an altitude of 160 feet (48 metres) above the sea level. This is an admirable site for a masonry dam. Only the foundations would have to cross a layer of 11 to 14 metres of alluvium, over which the river flows. This part can be made either by pumping the water from the excavations or by using compressed air.

The old Panama Company had planned a dam at this place in order to control the floods of the Chagres by the formation of a regulating lake, the maximum elevation of which was to be also 60 metres above sea level. By an almost incredible error, the new Panama Company had, without any plausible reason, abandoned this perfect site and transported to Alhajuela, 16 kilometres (10 miles) higher in the valley, the dam which it was intended to construct there.

The Isthmian Canal Commission, in its

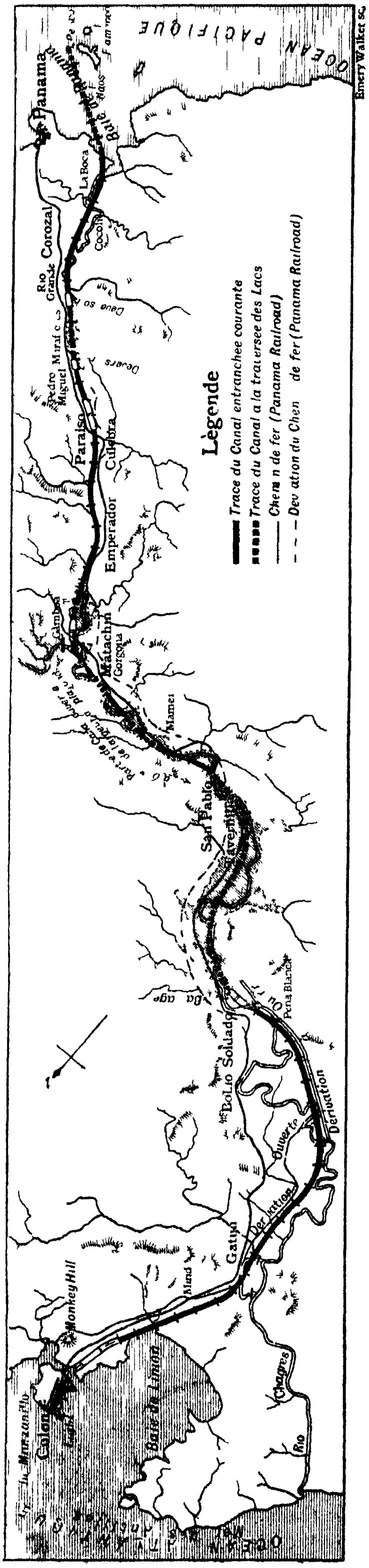


FIG C —PLAN OF THE PANAMA HIGH LEVEL LOCK summit elevation 130' (See Appendix p 271)

project for 1905 for a sea level canal, came back to the ideas of the old company, and again proposed the same site and same maximum level (200 feet above sea level) The erection of this dam and the subsequent formation of the lake, is an absolute necessity for the execution of the Straits of Panama, the essential organ of the excavation by dredging

In addition to the fact that the old company, and later the Isthmian Canal Commission, had destined the Lake of Gamboa to be the regulator of the Chagres floods, I proposed —

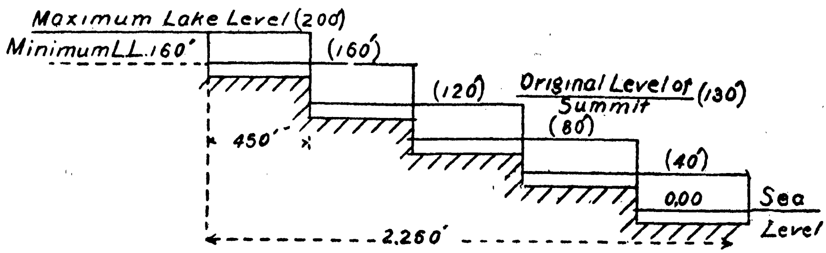
1 That it becomes the receiving basin for all the material dredged, from K 24 to K 62, that is to say, on the whole extent of the Isthmus with the exception of the maritime parts of the two valleys

2 That it becomes the generator of the electric power that will feed all the plant of the excavation and transportation

3 That it furnishes, by simple diversion into the dredging basin, both the water necessary for the maintenance of the level necessary for navigation, and the water enabling the transport barges to pass through locks from the level of the works to the level of the lake

A few figures will suffice to prove that the Lake of Gamboa can easily fulfil the four functions which are allotted to it The surface at 200 feet (60 metres) elevation above sea level is 11 209 hectares, or 43 3 square miles At elevation 170 feet (51 85 metres) it is 7,975 hectares (30 8 square miles) At 132 feet elevation (40 26 metres) it is still 3 857 hectares (14 9 square miles) The volume of this lake between the natural ground and the surface at elevation 200 feet (60 metres) above the sea, is more than 2,000 million cubic metres (2,600 million cubic yards) At elevation 160 feet, its capacity is still 950 million cubic metres, or more than twice the volume of the entire "Panama Straits"

I have proposed to devote all the space comprised between the surface at elevation 160 and the surface at elevation 200 to the part of controller of floods and water store It therefore becomes evident that there remains below the minimum level much more than is necessary for the storage of all the dredged ground It must be remarked that this magnificent depository basin is situated at about half-a-mile from the origin of the cut of the central mass, and that nothing is easier than to establish flights of locks between the working summit and the lake on the rocky sides of the hills which separate the lake and the canal cut.



We see that the system of dredging is certain of its most indispensable element of success; the presence in the centre of the Isthmus of a large and deep dumping basin, capable of receiving far more spoil than necessary.

The Central Mass now Presents Perfect Conditions for the Dredging.—Now we come to the dredging works proper. The central mass, with its maximum altitude of 333 feet, is now pierced, thanks to the work executed by the French companies, at the elevation of 157 feet above the sea (48 metres) except for a couple of hundred yards which have been kept 35 feet higher for the passage of trains. We can now pass from one ocean to the other without rising more than 157 feet (48 metres). Then by closing at the two extremities of the 11 kilometres of the central mass, by two small dams, the valleys of the Obispo and of the Rio Grande, to a level equal or superior to 157 feet (48 metres), all the central mass will be covered with a sheet of water, and dredges can be installed. But these dredges must float as high as possible in order to reach the highest ground.

In adopting as the first dredging level 170 feet (51·85 m.), the ground situated below this altitude of 170 feet would be removed by dredging. As to the higher grounds, it would be necessary to work them in the dry, and to throw them into the dredging summit from whence they would again be taken up by the dredges, and evacuated into the Lake of Gamboa. Another plan might consist in unloading them into the barges that will carry them into the lake. The volume thus to be treated amounts to about 25 million cubic metres (33 million cubic yards). (See Fig. E. in the Supplement and Explanatory note in Appendix, p. 272.)

As we have frequently said, the essential difficulty in the dry does not consist in the excavation; it consists in the transportation and the dumping.

The excavation of the higher part of the cut, with the immediate precipitation of the waggon-loads from the height of fixed stockades into the dredging summit, will become relatively easy. The actual cost of the excavation would thus be easily reduced by one half, according to the decomposition of the expenditure furnished to the Consulting Board, and the excavation power could be easily quadrupled. These excavations reach at present 250,000 cubic yards per month in the Culebra Cut. We might, therefore, reckon that the clearing of the upper part could be carried out in this manner at the rate of 12,000,000 cubic yards per year, that is, in three years.

As the average production of the dredges in the main cut may be, as I will show, based on an annual production of 30,000,000 cubic yards, there will result from this digging out a surplus time of two years, and a surplus expenditure of about £2,400,000 sterling, or 12,000,000 dols., or 60,000,000 francs. After this first work had been executed, the dredges would work regularly, lowering successively the level to that of the oceans.

On the 11 kilometres of the main cut, 16 large dredges could easily be installed which, even with the absolute minimum returns of 7,000 cubic yards per 24 hours, would produce more than 100,000 cubic yards per day, or 30,000,000 cubic yards per year.

The 260,000,000 cubic yards (199,000,000 cubic metres) of the main cut would therefore be removed in little more than eight and a-half years, if we had not to reckon two years more for the removal of the upper part. The duration of this cyclopean work would, therefore, not exceed ten and a-half years, from the time when the dams and locks giving access to the lake would be opened. As we must reckon four to five years for this preliminary work, the execution of the Panama Straits is possible in fifteen years. This period, which is so short if we compare it with that of 60 to 70 years required by the working in the

dry, is not to be considered optimistic. With the dredges — and especially the electric dredges—the delays would be reduced to a strict minimum and the yielding which we have admitted for the dredges, allows a margin of security equal to the figure itself. Neither can we admit that the work to be executed, in addition to that of the main cut, might delay the term fixed for the end of the undertaking. In fact, in the maritime parts of the Isthmus, between Colon and K. 24, on the Atlantic, and between K. 62 and Panama, on the Pacific side, the ground would be excavated and then transported to the sea or pumped and deposited by water on the banks of the valley. (Excavation on the maritime section of the Atlantic side, 87,000,000 cubic yards; excavation on the maritime section of the Pacific side, 37,000,000 cubic yards.) As regards the sections comprised between the maritime parts and the main cut, they would be dredged like the preceding ones, and the material would go into the Lake of Gamboa.

When the level of the water will have descended from 170 feet to an altitude of 60 feet in the main cut, dams across the Rio Grande and the Chagres will spread to this same level the sheet of water from K. 24 to K. 62. New dredges would be operated, independently of the others in these sections, and the spoil from them would be thrown into the Lake of Gamboa, either by transportation through the locks or by pumping them into the lake. Of course a part of the spoil could be also in these sections deposited or pumped on the sides of the valleys, and the work of dredging begun before the dredging level in the Culebra cut is lowered to 60 feet elevation. (Excavation from K. 24 to K. 46—170,000,000 cubic yards in the Chagres Valley. Excavation from K. 57 to K 62—45,000,000 cubic yards in the Rio Grande Valley.) At this period, the point of access for the barges to the Lake of Gamboa, the foot of the flight of locks being near K. 46, will be about the middle of the long dredging summit extending from K. 24 to K. 62. It would be at about three kilometres (two miles) from the mathematical centre of this summit. In this manner the average of the distance to be gone over in the dredging summit, which was 5½ kilometres in the first phase, will be 11 kilometres in the second. It will be, therefore, very small during the whole period of excavation.

Nature of the Ground in the Culebra Cut.—The mass of the Culebra cut is composed, through almost its entire length, of hard clay, which barely deserves the name of rock. The Isthmian Canal Commission, in their report of 1901, have given a very accurate definition of the nature of the rock:—

"There is a little very hard rock at the eastern end of this section (Culebra), and the western two miles are in ordinary material. The remainder consists of a hard, indurated clay with some softer material at the top and some strata and dikes of hard rock. In fixing the price it has been rated as soft rock, but it must be given slopes equivalent to those in earth. . . . . Probably nine-tenths of the material would naturally be classed as hard clay of stable character."

If we admit that the average hardness is that of the sandstone of the Manchester Canal, we shall make an estimate probably two or three times too high, surely double.

Quantity of Hydraulic Power Necessary.—As we have seen already, the figures furnished by Mr. Hunter, Chief Engineer of the Manchester Ship Canal, and published in *Engineering* of August 17th, 1906, establish the fact that the minimum amount of rock broken, with a 12 tons cutter, was 225 cubic yards per day, with two shifts working ten hours each, which corresponds to about 270 cubic yards for a 24 hours' work with three shifts of men. Let us admit the extreme minimum of 200 cubic yards per day. Therefore, if the $\frac{9}{10}$ths of the whole of the Culebra cut, instead of being hard clay scarcely fit to be called soft rock, were of the hardness of the average Manchester rock, it would require 500 rock cutters of 12 tons to disintegrate and make dredgable 100,000 cubic yards per day. But, as we have said, owing to the softness of the Culebra rock, the Lobnitz rock cutters will on an average yield three times as much. If, for safety, we reckon only twice, we should be led to say that 83 pontoons with three rock cutters of 12 tons on board would do the work. As the cutters are raised about 10 feet (3·05 metres) every 15 seconds, it would require a mechanical power of 32 horse-power per cutter, that is 8,006 horse-power for the whole, which, reckoning only 50 per cent. for the yielding, will correspond to 16,000 horse-power at the falls generating the power. The results would be considerably improved by increasing the weight of the cutters from 12 to 40 or 50 tons, but we will not take this into account so as not to base our calculations on experiments yet to be made.

The dredging would be made by 16 electric bucket dredges, every dredge having five barges carrying 2,000 tons for the transportation and disposal of the spoil. These

barges would be supplied with propelling electric apparatus of 50 horse-power. Reckoning an average employment of 200 horse-power for each dredge, and 200 horse-power for the five barges, the extraction and the transport would also require 8,000 horse-power.

The whole of the operations of the works on the central mass, K. 46 to K. 57, will, therefore, necessitate a fall of water of 32,000 horse-power. The works to be made on the sides of the central mass from K. 24 to K. 46 and from K. 57 to K. 62, will require the assistance of naval plant of equal power but without Lobnitz rock cutters, and this will demand a new hydraulic power of 16,000 horse-power, that is 48,000 horse-power in all. The whole of these requirements will be assured by the falls of the Gamboa and Bohio Lakes.

The average supply from the Chagres at Gamboa, according to the regular returns made during a period extending over more than the last 20 years, is 100 cubic metres per second, but during the three months of dry season it falls much lower than the average.

The volume of the Gamboa Lake comprised between the elevation 170 feet (51·85 metres) and elevation 200 feet (61 metres) is 877,668,000 cubic metres. If the lake is full at the end of the rainy season, it can supply during more than 100 days 100 cubic metres a second, without falling below the level of 170 feet, and without receiving any water from the upper valley. This reserve thus ensures the constancy of the average supply during the dryest period.

As 30 cubic metres per second will be required for the working of the locks giving access to the lake when the dredging is in progress, between K. 24 and K. 62, 70 cubic metres would remain free for the generation of power. The Gamboa fall should be reckoned between the maximum level of the Bohio Lake (60 feet) and the minimum level of the Gamboa Lake (170 feet), that is, 110 feet (33·55 metres). The hydraulic power, therefore, is 31,200 horse-power. It is therefore practically equal, under the worst conditions, to the demands of the excavation of the central mass.

On the other hand, at Bohio, we will have at our disposal a minimum of 100 cubic metres running from Gamboa, and, on an average, of 150 cubic metres a second.

The supply of 100 cubic metres, falling from the minimum height of the Bohio Lake (50 feet or 15·25 metres), will produce 20,000 horse-power. The minimum total power developed will be, therefore, more than 50,000 horse-power during the period of the lowest waters, and will satisfy the requirement of 48,000 horse-power necessary for the work outside of the maritime parts. This latter work will be carried out by steam power; the spoils will be transported into the sea or pumped on to the valley sides.

Amount of Men and Money necessary.——After noting that Nature has placed exactly at the desired spot the necessary mechanical powers for this gigantic displacement of masses, let us see how few men are necessary to direct this power in order to attain the end in view. The working of the central mass will require 16 electric dredges worked by 10 men, 85 pontoons worked by 9 men, 5 barges for each electric automotor dredge, each worked by 2 men. This makes an effective force of 1,067 men, and with three gangs at work, 3,201 men per day, or 3,500 men if we include the staff of electricians, men at the locks and the workmen who are attending to repairs, &c. This force will be increased by 1,000 men when the valleys of the Chagres and the Rio Grande are attacked, for in these regions the almost complete totality of the ground is loose and directly dredgable. The immense work to be carried out between K. 24 and K. 62 only demands, therefore, a force of from 3,500 to 4,500 men, that is an average of 4,000 men.

As is necessary in tropical countries, instead of repairs made at the shops new pieces will take the place of those out of order, and repairs on the spot will be reduced to a minimum. Admitting the excessively high average salary of 12 shillings, that is 15 francs, or 3 dollars, per day of eight hours, so as to include in this amount the expenses of the superior technical management, the daily expense would be 2,400 pounds sterling, or 12,000 dollars, or 60,000 francs; that is, for 300 days of work a year, an annual expenditure of 720,000 pounds sterling, or 3,600,000 dollars, or 18,000,000 francs.

The expense in ten years and a-half would be 7,560,000 pounds sterling, or 37,800,000 dollars, or 189,000,000 francs for the work exclusive of the maritime parts	£7,560,000
If we add—	
1. An equal amount for repair pieces	£7,560,000
2. A sum of £5,000,000 for construction of the locks giving access to the Lake of Gamboa, the Gamboa dam (this latter work was valued at £1,000,000 by the	

Isthmian Canal Commission), the smaller accessory dams, the electric installations, &c.	£5,000,000
3. A sum of £2,000,000 for the excavations to be made in the maritime parts of the Isthmus, K. 0 to K. 24 and K. 62 to K. 75	£2,000,000
4. A sum of £4,000,000 for the dredging, transporting, and rock-crushing plant	£4,000,000
5. A sum of £2,400,000 for surplus expenditure pertaining to the excavation of the part of the Culebra cut above 170 feet of altitude	£2,400,000
We reach a total of	£28,520,000
and by adding for unforeseen contingencies	£1,480,000
we obtain the total above-mentioned of	£30,000,000

or 150,000,000 dollars, or 750,000,000 francs.

The mere statement of the elementary figures shows what a considerable margin exists between the valuation and the probable reality. I have the firm conviction that the total expense will not reach two-thirds of this amount, and will be limited to twenty million pounds sterling, or 100,000,000 dols., or 500,000,000 francs, that is one-ninth of what the execution of this gigantic conception would cost in the dry. Those who have a less optimistic view about the cost of dredging operations may double or even treble the cost of labour and repair pieces. They will not reach more than £60,000,000, a still perfectly admissible sum for such a result. It is this over-conservative estimate of £60,000,000 which I gave to the Consulting Board in 1905.

After having shown how the rational utilisation of the topography and the dynamics of the Isthmus allow of the easy and low priced execution of the hitherto chimerical work of the creation of a Straits across the Isthmus of Panama, let us examine what this magnificent road would be when once brought into existence.

Management of the River Floods.—The three large rivers of the Isthmus are the Chagres and its two large tributaries, the Rio Trinidad on the left and the Rio Gatun on the right. They fall in the Chagres between Bohio and the sea. The Chagres, domesticated by the lake formed by the Gamboa dam, would have no more alarming floods and would empty into the Straits the pure lake water. The highest floods measured at Gamboa during a quarter of a century have risen to 1,600 cubic metres a second; the lowest water noted corresponds to a supply of 11 cubic metres per second.

There was a flood in 1879, which is said to have risen to 2,040 cubic metres per second at Gamboa, but it was not measured and is a mere conjecture. The duration of the rise of the floods is short and lasts at the most 48 to 72 hours. Caused by the passage of a cyclone they disappear with it. The total of the mass of water delivered by the Chagres at the rate of 1,600 cubic metres per second, in 48 hours continuously, is 276,000,000 cubic metres. It must be considered as a practical maximum of exceptional flood. If nothing flows off into the Straits, it corresponds to a variation of the lake level of 2·9 metres, or 9 feet 8 inches.

We have said that the volume of the lake at elevation 200 feet, is about four times the volume of the excavation of the Straits of Panama, which will be dumped into it. It will lose, therefore, by this operation, less than a quarter of its surface, since the spoils will be deposited against the dam in the deepest part of the lake.

These figures show with what facility the control of the Chagres waters will be effected by the Gamboa Lake after the excavation of the Straits. Between K. 24 and K. 44 the Straits will receive direct the waters of the small rivers which will flow into it. Their sediments are slight, like those of the Chagres, and it will be easy to diminish them still more by breaking their slopes by means of small dams. The volume of water supplied by these small rivers rises in these exceptionally short and rare floods to 600 cubic metres per second. Even if we figure on 800 cubic metres per second every three or four years, for 48 hours, the section of the Straits being on an average about 2,500 square metres, this supply will only produce a current of 0·32 metre per second, that is 0·6 knot, if all flows on one side; 0·3 if half goes to the Pacific, and the other half to the Atlantic. Between K. 24 and the sea, the old bed of the Chagres, completed by river diversions which are existing with the exception of one that remains to be opened, will take straight to the sea the waters of the Trinidad, of the Rio Gatun and of the other small tributaries falling between the Atlantic and the kilometre—24. Therefore no contact will exist between those rivers and the Straits in the maritime part of the canal on the Atlantic side.

On the Pacific slope the rivers have insignificant floods and will flow into the Straits

direct. Thus the question of the Isthmus rivers is completely solved with the Straits, while with a sea-level canal of narrow section the problem is difficult to meet completely. It has caused a great deal of ink to be spilt, and with reason.

Indestructibility of the Inter-oceanic Passage.—The "Straits of Panama," that unique artery for the world's commerce, must have as its essential quality—indestructibility in case of war and in case of a grave seismic commotion. The "Straits of Panama," with their width of 600 feet (180 metres) at the water level, their bermes of 100 feet (30·50 metres) on each side, defy all land slips. They need no locks, that plague and constant danger of summit level canals, or of sea-level canals with tidal gates. The only work of art which will exist after the opening of the "Straits" will be the Gamboa dam. But after the construction, this dam will, in reality, have disappeared. The hundreds of millions of cubic yards placed in the valley above the dam will have filled the valley for several kilometres, and this huge deposit will form the veritable and indestructible dam that no explosion of dynamite and no earthquake will be able to affect. Some millions of cubic yards of rock dumps will also have buried the lower face of the dam, rendering it inaccessible and immovable. We may say that the "Panama Straits" will not depend on any work of art, and when once made will have neither locks nor dam.

Nature of the Water-way Created.—It will be a veritable natural road of about the width of the Thames (the width of the Thames at low tide at London Bridge, 650 feet); it will be one-third of the width of the Bosphorus, it will be a water-way where ships will be able to navigate freely, crossing each other as in a large maritime river, with plenty of water on their sides or below their keel. The transit will be made in four or five hours.

Such are the characteristics of this artery, so desirable and so easy to realise if technical blindness did not lead a great nation, like America, to an inconceivable negligence of the clearest and most perfectly demonstrated scientific progresses of our days. By persisting, as she does, in turning her back on progress, and exhausting herself in a useless and ridiculous work, American genius does not see that it is now losing a terrible battle.

The defeat that reason is suffering now in America will weigh heavily on the prestige that American genius had so justly acquired hitherto. It is abjuring at the present day the very doctrine which had made its fame, the increase of machine power and the decrease of the mechanical action of man. We have every right to err as long as scientific truth has not been revealed, but from that moment, to neglect it, to turn our back on it, is to decline. It is lowering one's self willingly in the intellectual hierarchy of humanity.

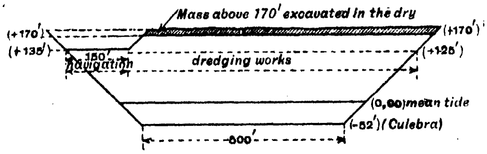
Part II.

Provisional Lock Canal.

The complete solution of the problem, otherwise insoluble, of the enormous labour necessitated by the excavation in the dry, of the Panama sea-level Canal; the possibility of creating veritable "Straits," invulnerable in case of war or earthquake, and that, for an expenditure at the utmost equal to the least costly of the lock canals with a summit level—such are not the only consequences of the substitution of the work on the water or the work in the dry. (Estimates of the Isthmian Committee for a lock-canal with 85 feet altitude, 28,800,000 pounds sterling; Report of 1901. Estimates of expenditure for a sea-level canal, 64,400,000 pounds sterling; document of 1905. Estimates for the Straits of Panama, 30,000,000 pounds sterling.) There is another consequence, likewise a most important one.

During the four to five years necessary for the construction of the dam at Gamboa:—1. If locks be erected at the extremities of the 11 kilometres of the cut of the central mass, and towards the extremity of the maritime parts of the valleys of the Chagres and of the Rio Grande, at the spot that I have indicated as the limits of the two successive dredging levels. 2. If digging in the dry is continued down to elevation 95 feet (28·97 metres) through the passage already opened across the Culebra down to elevation 157 feet (48 metres), a lock canal with a summit level at 130 feet elevation will have been created without great effort, and in a short space of time, between the oceans and at the same time the dredging basins necessary for the execution of the Straits of Panama. (See Fig. C, p. 252, and Fig. D. in Supplement.) The enormous width of the cut will always allow of housing simultaneously vessels in transit, the Lobnitz lock-cutters and the dredges. The transit demands only a band of 150 feet (45·75 metres) and at 130 feet above the sea, the cut will be six times as broad as that and four times as broad at the sea level. It will suffice to insure navigation, at every depression of the water level, to

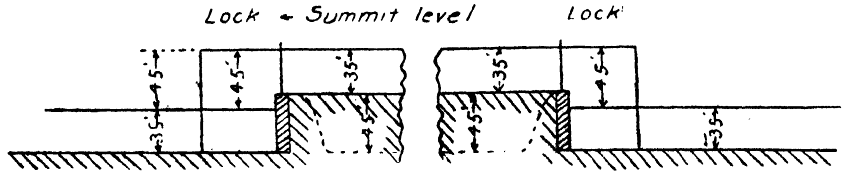
reserve a channel that will have been previously deepened, in order to afford the necessary water depth, notwithstanding the lowering of the water level. The process is so evident and so easy that it is not necessary to dwell on the subject at any length.

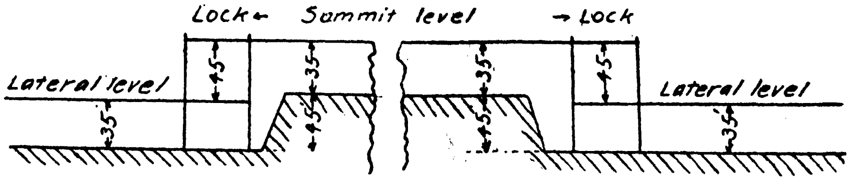


A more serious question remains. What will happen with the locks when the level is lowered? There will be a material impossibility with the usual construction of locks. I have supplied a most simple solution to this problem some twenty years ago. Let us consider a navigable level closed by two locks of the usual type, that is to say, by lock having an upper gate of a height equal to that of the water depth of the level the lock closes, and a lower gate with a height equal to the sum of the water depth and of the fall of the lock.

repeated as many times as is necessary to bring the summit level to the same level as the lateral levels. When the levels of the summit level and the lateral levels are the same, the gates of the lock are taken away. There remains nothing then but the masonry work which is a mass of artificial rock in the new and single summit level, formed by the old summit level and the old lateral levels. This artificial rock is removed as any other rock that is met during the excavation. If the locks are "in flight" by taking dispositions, inspired by the same principle, their gradual elimination is also insured while the transit is going on. It is in this method of construction that the key to the transformation of a lock canal into a sea-level canal resides.

I proposed, in 1887, this method to the old Panama Company in order to secure, in a brief delay, the opening of the canal with locks and to continue later on the excavation of the sea-level canal. I did not then go into the question as far as I am doing to-day. I did not show then the facility for obtaining by this transformation, not only the sea-level canal, but also the "Straits of Panama."





It is evident that with such a lock no lowering of the level is realisable without altering the lock, that is to say, without stopping navigation. But if the upper gate be made with a height equal to that of the lower gate, and if the summit level be deepened on a length of two or three hundred metres above the lock, the entire difficulty vanishes. For instance, one metre of the summit level may be dredged without touching the lock. This deepening accomplished, the level of the water may be lowered one metre without modifying either the circulation of ships or the operation of the lock. This dual operation should be

In those days, only one thing could be guaranteed, namely, that the excavation of the rock of the canal would not cost, if excavated under water, more than in the open air. Now, thanks to the progress made in dredging, thanks to the application of electricity as motor power for the dredges, which I realized for the first time on the River Esla in Spain, in 1895, thanks finally to the progress achieved by the Lobnitz method, in the economic desagregation of rock formation of any hardness, a progress which took place only during the last few years, it is possible to go to the extreme limit of the method and to project the

"Straits of Panama." The great objection to my method of handling the Panama problem has disappeared. The extraction of rock under water already in Europe requires only half the expenditure of its cost in open air. The figures given by the chief engineer of the Manchester Canal, Mr. Hunter, establish it. To the 9d. which the desagregation of the rock costs in the Manchester Canal, if we add 2d. or 3d. for dredging on a large scale, we arrive to a price about half what would cost a similar work in the open air (2s. a cubic yard in the dry). In the Isthmus, this difference increases in enormous proportions on account of the cost and inferior quality of labour, and of the fatal interference of diluvian rains with the works in the dry, especially as far as transport and dumping are concerned, two elements of which the dredging is free.

Opening in Three Years to Limited Shipping or to Military Navigation.—But however rapid the execution of an inter-oceanic passage, at elevation 130 (about four years), this period may be still more shortened, and if, for instance, it was desired to open in three years' time a passage limited to military navigation, it would suffice to add a fifth lock on each side of the Isthmus and to pass in the central cut at an altitude of 170 feet, that is of 52 metres. (See Fig. E. in Supplement.)

The work done by the French companies has, at the present day, opened up a passage at 157 feet, across the central mass, so that it would be sufficient to have only 17 feet excavated on a limited longitude to have the canal bottom at 140 which will give immediate passage. Practically we may say that no excavation of any importance would be necessary in the central mass for that level.

On the other hand, for a lock canal at elevation 170, the erection of the locks may be very much shortened if we limit the masonry to the head of the locks, and if we take the natural slopes of the excavation in their nude state as the lateral walls of the lock, and if we build only one lock instead of turned locks. We would thus reduce to almost nothing the mass of masonry that is necessary for erecting the locks. Of course it would need more water to do the lockages, but this is insignificant—if it is desired to establish military communications only, that is to satisfy a limited traffic.

Finally, whilst constructing the dam at Gamboa, we can, now, provide against the delay of four or five years that it demands, by the installation of pumps to elevate into the summit level the water required for the lockages of the inter-oceanic limited navigation.

One question only remains open in this condensed programme. It consists in the opening of the outlet of the Lake of Bohio. This outlet should be normally made through a saddle between two hills at some distance from the axis of the canal, and may demand two or three years' work. Here, as elsewhere, the problem may be simplified, by making the Chagres flow into the main cut itself, that has been opened for the canal by the old Panama Company. This cut has been excavated through a resisting rocky mass and lowered to 12 metres above the sea. Nothing would be easier than to broaden, in the space of one or two years, this cut, so as to allow the Chagres to flow on the side of the locks installed in the same cut, which will also open up the passage from the Atlantic level to that of the Bohio Lake level.

PART III.

PAST AND PRESENT WORKS AND PROJECTS.

Results of the Work of the French Company.—It will have been seen how the question of opening to traffic may be simplified, if one wants to clear it of an absurd dogmatism and look only at the work to be realised in making use of the great results actually obtained.

The work of the old Panama Company has, in reality, cleared away entirely all the great difficulties of the undertaking. The work of that company has advanced the undertaking to such a point that the rational solution that I have indicated may be applied, and the execution of the "Straits of Panama" may be commenced now with the exclusive employment of natural conditions and natural forces. The work done by that Company if used in a logical way, can allow both the beginning of the construction of the "Straits" and the opening up to traffic, under more or less perfect conditions, according to whether it is decided to devote three years or from four to five years to open the transit. In any case, this premature opening will constitute a most stupendous service to humanity, and the tax of transit will cover entirely the expense involved in the further construction of the "Straits of Panama."

The Fundamental Error of the Consulting Board.—In September, 1905, at Washington, I presented the question of the "Straits of Panama," under a form slightly different from that which I adopt to-day be-

fore the Society of Arts. It was then my desire to show that everything converged towards a rapidly constructed lock canal with a high summit level which should be transformed later on into a veritable Straits. As I have already said, this proposition, "the high level lock canal first, the Straits of Panama afterward," did not gain the day with the Consulting Board, which would not hear of the method of excavation by dredges, and maintained, against all theoretical and experimental evidence, the work in the dry.

This great and deplorable error is the same that was the cause of the decision taken by the Congress of 1879, assembled by M. de Lesseps, in Paris, and by all the Commissions that, successively, have studied the Panama problem. But, contrary to what happened in the Congress of 1879, the Consulting Board was placed in presence of the technical solutions which I brought, and which twenty-six years of progress in the realms of science and industry have rendered so productive in striking results.

As the Congress of 1879 had nothing before it but the work in the dry, that body may be excused for not having seen further; the Consulting Board in 1905 had everything before it, and is without excuse for having closed its eyes. It is not without interest, from a philosophical point of view, to note that the same error generated identical consequences at an interval of 26 years.

In 1879, two projects obtained the preference of the Conference, the project favored by M. de Lesseps, the sea-level canal with tidal locks, and the project elaborated by a great French engineer, Godin de Lépinay. The latter consisted of the construction of dams at the two extremities of the Isthmus, one at 10 kilometres from the Atlantic, at Gatun, across the Chagres, and the other across the valley of the Rio Grande, in the proximity of the Pacific. (While indicating Gatun, Godin de Lépinay reserved the question of the practical possibility of a dam there, and selected Bohio, 14 kilometres higher up, in case the Gatun dam should not prove possible.) These dams would keep the waters of all the rivers of the Isthmus, at 24 metres above the sea ($78\frac{7}{10}$ feet), and would constitute an interior lake, making the Isthmus of Panama an artificial Isthmus of Nicaragua.

Twenty-six years later, two projects identical with those of Lesseps and Godin de Lépinay divided the International Consulting Board at Washington in 1905. The majority, composed of three American and five foreign members*, voted for the sea-level canal with tidal locks; the minority, composed of five American members, voted for a canal with an interior lake formed by a dam at Gatum. The only modification made in the project of Godin de Lépinay was to substitute to the elevation of 24 metres ($78\frac{7}{10}$ feet), the elevation of 25·90 metres (85 feet) for the altitude of the interior lake. No essential characteristic of the project of Godin de Lépinay was, therefore, modified. Alone, his name remained buried in oblivion. (See Fig. A, p. 261, and Fig. B. in Supplement.)

The report of the minority of the Consulting Board makes no mention of the author of the project that it adopted. But the reports of the Congress of 1879 render him the justice that is due to him. It is the project of Godin de Lépinay that met with the favour of the American Government. And it was his project that it recommended to Congress.

Congress was thus placed between two detestable alternatives. The first was to adopt a shallow, narrow sea-level canal, to be dug in the dry, the construction of which could not be effected in less than 20 years, notwithstanding the affirmations devoid of all experimental basis of the majority of the Consulting Board, who solemnly declared that it would require only from 12 to 13 years. The second alternative was to adopt a canal with perpetual locks. This latter solution was introduced to Congress as the American conception, the type of which is the Sault Sainte Marie Canal, by the President of the United States, in opposition to the European conception of the sea-level canal, the type of which is the Suez Canal.

This view is, of course, erroneous; we know that the first lock canal, with a summit level. was built in France, between the Atlantic Ocean and the Mediterranean, by Riquet, under Louis XIV. We know the two great canals of Manchester and of Kiel are lock canals, and, finally, we know the project adopted was a French project, twenty-six years old.

The nationalist argument did not prevail, however, over the evident disadvantages of this system; the terrible accidents to which any false manœuvre would expose it; the

* Majority:—Messrs. George Davis, Barclay Parsons, W. H. Burr (American members); Messrs. W. Henry Hunter, A. D. Guérard, Eugen Tincauzer, E. Quellennec, Welcker (European members). Minority:—Messrs. Alfred Noble, Henry F. Abbott, Frederick P. Stearns, Joseph Ripley, Isham Randolph. (All Americans.)

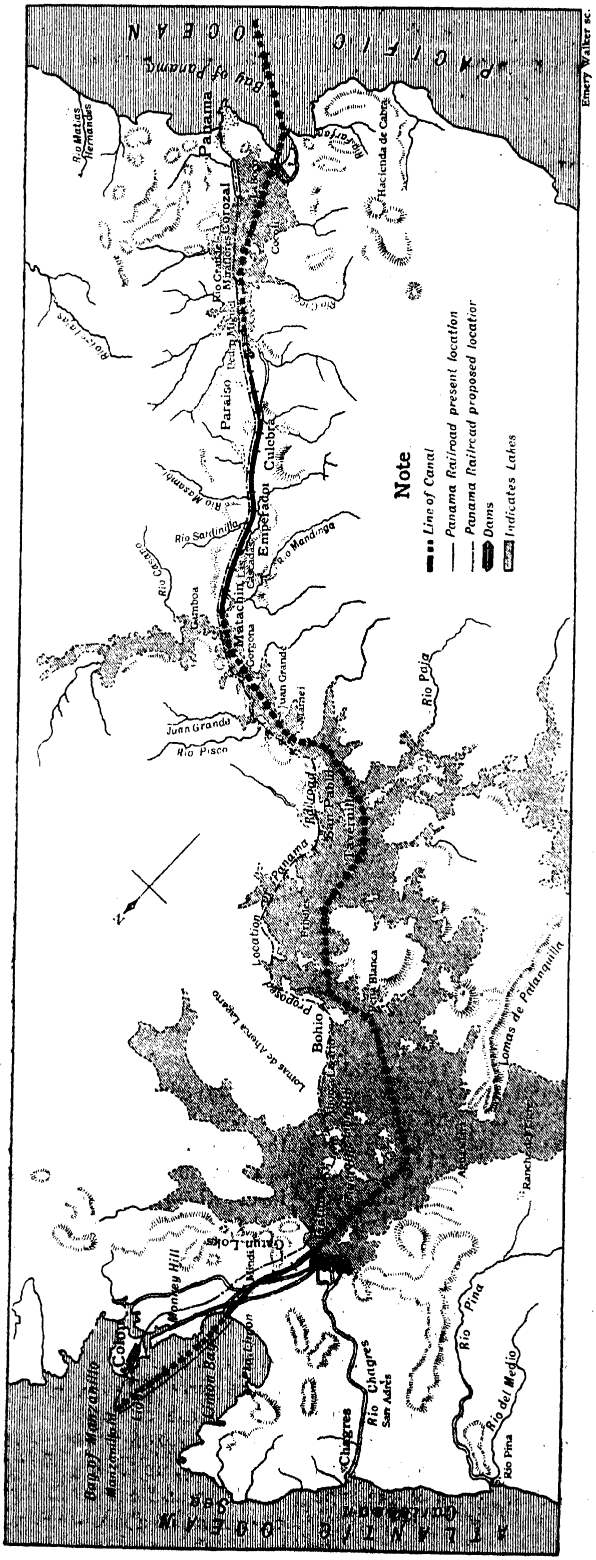


FIG. A.—PLAN OF THE PANAMA HIGH-LEVEL LOCK CANAL (summit elevation 85'). (See Appendix, p. 270.)

danger of destruction in case of war or of seismic commotion; without counting the compulsory limitation to traffic owing to the limited quantity of water from the rivers that feed it (58,000,000 to 96,000,000 tons, according to the futute average size of the ships).

That project was defended with tenacity by the Government, and even represented as superior to the sea-level canal. Such a theory is as vain as that of the surgeon trying to demonstrate that a wooden leg is superior to a natural leg, and it did not convince the American Senate.

Then, in order to save the project, it was thought necessary to return to my proposition, and Senator Knox, in a speech that decided the battle, showed that the proposed lock canal would later on be transformed into a "true sea-level canal," a canal from 500 to 600 feet wide and 50 feet deep; that is the type of water-way I had proposed and called the "Straits of Panama." The project was adopted.

It seems at first glance indifferent whether the first form of the lock canal be realised with a summit level of 85 feet, or with a summit level of 130 feet above the ocean, if precautions are taken to ensure the ulterior transformation into veritable straits. Nevertheless, it is wholly different. The cut to be made in the dry is 53 million cubic yards for an 85 feet summit level, whereas it is only 20 milllons for the summit level of 130 feet. Besides, if this summit level is but a preliminary phase, an opening may be made with a narrower passage requiring only 12 million cubic yards. The widening would immediately follow the opening. Now, if 3 million cubic yards can be excavated annually, as it is proved, it will require 4 years for the passage at 130 feet, and 17½ years for the complete cut, made in the dry, and necessary for the passage at 85 feet.

This example shows the radical difference in opening the cut for a provisory summit level at 130, or for a definitive summit level at 85. Of course, great exertions may and will reduce the term of 17½ years, but these efforts are wasted in a struggle against nature to obtain finally an inferior solution, much more difficult to transform into a sea-level passage than a higher lock canal.

It is not without interest to examine the consequences that have already taken place, of the great error committed by the American Government in the final selection of the type of the canal.

Present Condition of the Work done by the American Government.—On March 3rd, 1881, the Universal Company of the Panama Canal was formed, and in November, 1883, the final plans were approved. We may take it for granted that one year and ten months were spent in studying, in boring, in clearing the virgin forest, in transporting the first plant, in building the houses and hospitals, and—in a word—in organising life and work in what had hitherto been wilderness. Three years after the beginning of actual works, by the 1st January, 1886, about 15,000,000 cubic metres (20,000,000 cubic yards) had been excavated. The totality of the constructions then covered a surface of 217,184 square metres (260,000 square yards), that is to say, a surface equal to that of a band extending along the canal from one ocean to the other, 3·2 metres or 10·5 feet in width. These constructions have since then been very much increased, and now cover a still larger area.

On January 31st, 1886, while I was chief engineer of the company, I had the honour of exceeding in the quantity of work executed, the total of 1,000,000 cubic metres per month (which for a long time had been aimed at), and of producing 1,067,823 cubic metres (1,397,000 cubic yards), during the month of January. The work was interrupted at the end of 1888; the total cubic volume executed by the Lesseps company amounted then to 72,000,000 cubic yards—the official figure furnished by the Isthmian Canal Commission in its reports of 1901 and 1906—which corresponds to an average cubic monthly output of 1,000,000 cubic yards during the six years of effective work. To this figure must be added about 8,000,000 cubic yards, executed by the new Panama Canal Company, between 1894 and 1904, the year when the American Government purchased the canal.

The value of this immense quantity of works, installations and plant, was estimated by the Isthmian Canal Commission, in round figures, at 33,000,000 dollars, that is £6,600,000 sterling, or 165,000,000 francs. It may be added, however, that the Commission only took into account 39,586,332 cubic yards as the sole part of the excavation that could be utilised in the execution of the plans it had adopted.

Since the recommencement of the work by the American Government, that is to say since April 1904, up to the end of 1906, the amount of the ground extracted for the excavation of the canal is about four million cubic yards.

In addition, dredgings have been executed at Panama and at Colon, but they have been done rather with the object of keeping in order the present installations. The total sum spent by the American Government in installations and work, up to the end of 1906, amounts to about 40,000,000 dollars (£8,000,000), that is to say to seven million dollars more than was paid to the French Company for their works, plant, and installations, according to the American estimates. The Isthmian Canal Commission certainly believed that it would produce a similar quantity of work, plant, and installations for an equal sum. We see now that with a much higher expenditure, four million cubic yards are excavated within about three years instead of 72,000,000 within six years. It would not be correct to suppose that the buildings, hospitals, and shops were no longer fit for use, and that new constructions had replaced them. The report of the Chief Engineer, Mr. Stevens, established on June 30th, 1906, the following statistics on the present distribution of the dwelling places :—

White married quarters—	
Built by the French	235
,, ,, Americans	73
Coloured married quarters—	
Built by the French	297
,, ,, Americans	20
White bachelor quarters—	
Built by the French	163
,, ,, Americans	12

It must be added that the work accomplished by the Americans in the sanitation is deserving of the highest praise. They have reproduced in Panama what they so perfectly did in Cuba five years ago. It is based on the application of the theory of Carlos Finlay, the Havana doctor, who discovered the origin of yellow fever a quarter of a century ago, and was not listened to until the admirable experiments of the American physicians demonstrated that it was true. But this work of prophylaxy consists especially in a rigorous sanitary police and does not require heavy sacrifices of money, nor the employment of a very great number of men. It has not interfered with the works of excavation proper. However, the success in stamping out yellow fever caused by the stygomia, a house mosquito, did not crown the efforts made against malaria, caused by the anopheles, a marsh mosquito.

During the first two years the small results of the works were explained by the need of a systematic organisation. "We have made 240,000 cubic yards in April," said Secretary Taft before a Committee of the House on May 24th, 1906, "but we have not begun yet, we are just ready to begin." In April Mr. Shonts in a report to the Secretary of War (Mr. Taft) wrote that a 1,000,000 cubic yards monthly excavation would be obtained from July on, but the maximum reached ever since was 325,000 cubic yards. Up to the present day the American Government has met only with bitter surprises.

PART IV.

CONCLUSION.

The general cause of the specified failure suffered by the Americans in the execution of the work and in the selection of the elevation of the first navigable summit level (not to speak of the unseemly error to dam the Chagres at Gatun), is due to their ignorance of the injurious influence of the rains on the excavation in the dry in the tropics. They have overlooked this essential element, which is the key to the whole situation, and they have refused to take into account the necessary system of excavation on water which appeared to me as the final teaching of the bitter experiences of the old Panama Company.

The Americans thought that by increasing the size of excavators, of cars, of locomotives, the cubature excavated would increase proportionally; but the contrary proved to be the case, as was to be expected.

A short extract from the message of President Roosevelt of December 17th, 1906, clearly brings out the fact :—

"The implements of French excavating machinery, though of excellent construction, look like the veriest toys when compared with these new steam shovels, just as the French dumping cars seem like toy cars when compared with the long train of huge cars dumped by steam ploughs which are now in use."

A little further on he says :—

"In the rainy season the steam shovels can do but little in dirt, but they work steadily in rock or in the harder ground."

President Roosevelt might say of the huge cars what he says of the steam shovels and add that, over the lines of the earth excavation works, these cars are permanently off the rails and not on them. (See Fig. G., p. 264 for the American plant, and Fig. K., p. 244 for the French plant.)

If the old Panama Company had committed the unpardonable mistake of measuring the weight of the locomotives and cars, according to the importance of the cut, and not according to the conditions resulting from the

G.—AMERICAN SHOVEL AT WORK. (See Appendix, p. 272.)

ground and from the rain combined, if it had chosen the present American plant, it would have done absolutely nothing during nine months out of twelve. In fact, the President tells us that this plant accomplishes nothing in the soft ground during the rains, and almost the whole of the cuts, at the time of the French works, were in ordinary clay, not in rock or hard clay, as are the Americans now, thanks to the low level reached by the French excavations. Certainly the American engineers did not take these facts sufficiently into account, or they would have hesitated to compare to toys the plant which, 20 years ago, excavated, with fewer men than they themselves now employ, 1,400,000 cubic yards per month, in a much more difficult ground than they have now, while the so-called perfected machinery which they use, only yield them a record of 325,000 cubic yards per month (October, 1906). This is less than one-third of the volume officially announced last April by the President of the Isthmian Commission, as that which would characterise the monthly excavation for the second half of 1906 (1,000,000 cubic yards).

For the excavation of the high parts of the mountains, for the enormous and necessary work which they have accomplished, the French engineers have, therefore, acted wisely in choosing the locomotives of 30 tons and the cars carrying 10 tons of ground, which the Americans disdainfully call "toys." The enormous work accomplished by the French engineers under such difficult circumstances, the inability of their successors to attain—even approximately—the results which they achieved, largely compensate for the slight ridicule which is mingled with the accusation cast at them—that of having employed toys for this great battle with nature. The value of weapons—like that of tools—is not to be measured by their weight, but by their efficiency.

I have established that now, at this present stage of the work, dredges and barges should be substituted for the early plant which was necessary and well determined in the first period, and not heavier locomotives or steam-shovels.

It was at the commencement of this new phase that the Panama Canal came into the possession of America. The American engineers either did not know or would not understand, the marvellous facilities which this new period offered them if the proper method was used. Either they did not know or would not understand, the philosophy of this great problem, and how the way was opened up before them to realize in four years a lock canal communication between the oceans, and eleven years later the immortal and generous creation of the "Straits of Panama." Is it too late for a reaction? No, if the great question were examined in a purely scientific spirit. Yes, if national vanity steps in.

At one time it seemed as if President Roosevelt wished to exclude all narrow national tendencies from the scientific search for the best solution. This was when, in April, 1904, he decided to ask the English, French, German, and Dutch Governnments to appoint technical delegates to the Consulting Board, who had to decide on the best plan.

Unfortunately the question again entered into the sphere of petty national considerations, when several months later the President of the United States, on the 13th February, 1906, wrote in his message to Congress recommending the permanent lock canal:—"It will be noticed that the American engineers on the Consulting Board and on the Commission by a more than two to one majority favour the lock plan, whereas the foreign engineers are a unit against it."

Scientific truth is neither English, American, French, German, nor Dutch; it is the scientific truth, and belongs to the whole human race. No doubt each branch of the human race may pride itself on having helped in the establishment of such truth, but to be limited by the geographical boundaries of countries in the search after truth is to stray into voluntary error. This error was committed by President Roosevelt when he recommended the canal with permanent locks as being the American solution.

The monstrosity of placing permanently the future of the commerce of half a continent and the military security of the United States in a project which would be constantly menaced by accidents or earthquakes so impressed the Senate that the Senatorial Commission of the Isthmian Canal rejected the presidential recommendation. The Senate was about to act in a similar manner, when, at the last moment, Senator Knox, on June 19, 1906, saved the proposition, as we have seen already, by depriving it of its characteristic of perpetuity, and by accepting my formula, "the high-level canal first; the Straits of Panama afterwards."

He said: "Because the lock type of canal can, if necessity ever arises, be transformed

Fig. H.—View of an Excavation in the Culebra Cut (see Appendix, p. 273.)

into a true sea-level canal, one of five to six hundred feet in width, and fifty feet or more in depth of water." It was my proposition in its general terms; it caused the Senate to rally, and the canal with locks was accepted. But the form thus adopted for the first stage of the construction of the Straits of Panama, had to bear the consequences of the error which presided at its conception. It comprises an unnecessarily deep cut to be dug in the dry, and a needlessly wide and dangerous dam across the Chagres at Gatun.

President Roosevelt, notwithstanding the optimistic tone of his message of the 17th December last, owned that this dam, an earthwork with a length of 7,700 feet, and holding water at 108 feet above the bottom of the bed of the river, would entail "some little risk." This is a serious expression coming from the lips of the head of a country when speaking of the keystone of the vast enterprise to be undertaken. The successive consequences of the initial error committed in the conception of the project are manifest in the carrying out of the work. The President in his message speaks of the record breaking excavation of 325,000 cubic yards of October. He does not remark that it represents less than one-third of what his engineers expected to follow immediately the end of the period of organisation. The President is also bound to inform Congress that in April next the location of the locks will be finally settled. This is to admit that the locks are badly placed, that suitable sites are being still sought for and that, therefore, the final plan of the Government has not withstood the test of the first experimental works.

All these material facts and the enormous sums of money (£8,000,000 or 40,000,000 dols.) spent in two years and eight months without producing any serious results, should sound the alarm and show that the wrong track is being followed, and this mournful road leads to a dangerous and uncertain plan, which will, perhaps, replace the inauguration fêtes by a fearful cataclysm. Heroic courage is certainly needed in order to return to the truth, and if there be a man capable of showing this it is President Roosevelt. His latest message, however, does not seem to indicate that we may hope for it. Confidence obviously inspires the President in spite of these facts. That it is not well placed is sufficiently indicated by the photograph which we extract from his message with the inscription placed below. The President has obviously been deceived into believing that a new level 65 feet below the one created by the French had been dug through the entire Culébra cut seven miles long. The excavation referred to is simply the removal of an embankment 200 metres wide, 35 feet high, left across the cut opened by the French for the passage of trains. (See Fig. H., p. 266 and Explanatory note, p. 273.)

Except for this removal there has been no substantial change whatever in the general level created by the French. The amount of excavation done by the Americans is obviously too small to have permitted the creation of a new level 65 feet lower than the one existing when they took possession or even anything approaching it.

I am deeply distressed about this, for I had ardently desired that the work undertaken by the United States at Panama might add to their glory and not turn into a source of regrets and sorrows. I have done everything in my power to show the right path.

For years I have combatted in the United States the erroneous solution of the Nicaragua Canal, which, for half a century had been supported by the unanimous scientific and political votes of the Americans. I have triumphed over this legend, thanks to the constant help and to the boundless devotion of two great American citizens, Mr. John Bigelow and Senator Mark Hanna, who knew how to place national interest higher than national vanity, and to bow before scientific truth without regard to the nationality of those who struggled to attain it.

Later, when Colombia wanted to oppose the resurrection of the Panama undertaking, I co-operated in the work of the Isthmian secession, and as Minister Plenipotentiary of the new Republic, I signed, with the Secretary of State, Mr. Hay, the treaty between the two Republics by which the Panama Canal was born out of its own ashes.

I have again met in the person of Mr. John Hay, the noblest and purest-hearted of men; and the great Trans-Atlantic Republic, in losing Mark Hanna and John Hay, has also lost the sincere counsel of the noblest patriotism. They were no longer the councillors of the Government when I accomplished the third part of my task, when I brought forward the dearly-bought experience acquired by the old Panama Company. I showed how the work should be executed and what should be the object aimed at: the "Straits of Panama"—which might easily be completed in 15 years, after having opened a passage in four years or even less. I have spoken to the

FIG. F.—INSTALLATION OF DREDGING WORKS MADE AT CULEBRA (1888). (See Appendix, p. 272.)

FIG. L.—RESERVOIR ON THE HIGH RIO GRANDE (1888). (see Appendix, p. 273.)

blind, who would not see; to the deaf who would not hear. Apparently what was wanted was something American, and what I brought forward was not American, though it was inspired by the American system of labour-saving appliances. The un-American system of labour-wasting appliances was considered for the first time as typical American.

Mr. Lindon Bates, a well-known American engineer, described this phase in a recent work ("The Crisis at Panama"):—

"When, three years ago, our Government took over the enterprise of the Panama Canal, it was with its proverbial enthusiasm. Our self-confidence was boundless. We would exhibit to the world how competent American business methods would put the water-way through. We had a subtle disdain for our predecessors—the impractical French. We tinctured in with pity: the visionaries. So we bought all their properties, channel right of way, railroad, charts, machines, scrap-heaps, and smiled, for we believed we had driven a Yankee bargain.

"One thing was overlooked, and the French, with idealistic generosity, threw it in. It had cost them six times what we were giving for their whole investment. Yet truly for us it was, of all, the most valuable asset —their experience. Had we bought it at a high price it might have been prized and have been let yield us precious saving service.

"But it too has been disdained, and in blind obliviousness, we head the old fateful way into the self-same pit.

"Labourers are wanted at Panama; the call has gone out from the Isthmus for fifty years.

"In the closing months of the French regime light dawned, and the word went forth—the minimum of men, the maximum of water-borne machines and land plant invincible to rain. This was the final dictum of a generation's experimenting." See Fig. F., p. 268, and Fig. L., p. 269.)

However this may be, I have done my duty as a sincere friend of the United States, and have endeavoured to point out to their engineers the road to be followed. At the same time—and this was my principal object—I have done my duty to my own country in showing that its engineers from the very beginning were equal to the great task which they had undertaken; in showing that our intellectual patrimony may claim the honour of having found the solution of the problem set by Charles the Fifth in 1523 to Cortes: Discover the Secret of the Straits (*el Secreto del Estrecho*).

This secret, as I have shown, is henceforth brought to light. It does not lie, as Cortes and his successors imagined, in the geography of the Isthmus, but in its topography and in its hydraulics. Everything has been prepared by nature for hydraulic power to lift, in the high valley of the Chagres, the earth and the rocks which obstruct the site of the Straits. Harness this power, and the Straits will be made by its spontaneous action. This is the "Secret of the Straits."

APPENDIX.

EXPLANATORY NOTES, FIGURES A. TO M.

A.—*Plan of the Panama High-level Lock Canal (summit elevation, 85') adopted by the American Government.* (Original project of Godin de Lépinay, 1879). (See p. 261.)

NOTE.—Godin de Lépinay had indicated the Gatun location for the dam in his plan, under the reserve that it would be recognised a possibility there; he said that in the contrary case the location ought to be Bohio, 9 miles up the river (14 kilometres).

The only reason which actuated the American minority of the Consulting Board in choosing Gatun, which always had been condemned ever since Lépinay mentioned it as a location for a dam, must be attributed to their great desire to prolong as much as possible the limit of exploitability of a lock canal. This limit is fixed by the minimum average yearly output of the rivers feeding the summit. This limit corresponds at Bohio to a transit of 40 to 60 million tons. As the Sault Sainte Marie Canal has already reached 44,000,000 tons traffic, a lock canal at Panama with the limit corresponding to the Bohio dam, could not be called but a temporary solution in America. With a dam at Gatun the water output is half greater than at Bohio, and the limit of exploitability is from 60 to 100 million tons. This enabled the minority to dispose of the objection which any lock canal at Panama finds, its narrow future. They even tried to go further and said the limit could be extended with more dams—this is erroneous, more dams do not give more rain.

B.—*Longitudinal Section of the Panama High-Level Lock Canal (summit elevation, 85') adopted by the American Government in* 1906. (Original project of Godin de Lépinay, 1879). (See Supplement.)

NOTE.—This project, recommended by the minority of the Consulting Board as the perpetual solution of the Panama problem, was endorsed by the American Government and proposed to the Congress of the United States (February 19, 1906). It was voted down by the majority of the Senatorial Isthmian Canal Committee, but was finally adopted by the Senate (June 21, 1906) on the strength of Senator Knox's declaration that it could be transformed "into a true sea-level canal, one of 500 to 600 feet in width, and of 50 feet or more depth of water," that is to say, into the "Straits of Panama" (Bunau-Varilla project, 1905).

The vital objections to this very bad solution is (1) The magnitude of the summit level cut to be excavated in the dry (53,000,000 cubic yards); (2) The erection at Gatun of a huge, dangerous, and badly-located earth dam, 7,700 feet long, of 21,000,000 cubic yards volume, holding the water 85 feet above sea-level, across a river, the bed of which is 22 feet below sea-level. The method of construction is the one proposed by Mr. Bunau-Varilla for the small and low dam at Bohio and consists in depositing dredged soil by means of centrifugal pumps. The ground, excellent at Bohio, is unfit between Gatun and the sea, being largely marshy silt incapable of settling; (3) The advantages offered by dredging in the transformations of a high-level canal diminish when the snmmit is lower, and more ground must be excavated in the dry above the level of work of the dredges; (4) The location of the locks in this plan are in a bad ground, and the site chosen has proved inadequate.

The longitudinal profile of the Panama Route shows:—

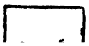
1st. The original natural ground along the axis of the canal.

2nd. The lowest point reached by the excavation in every cross-section. (Between this lowest point and the original natural ground the cut is entirely open, but necessitates in most places widening.)

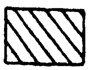
3rd. The water-level and bottom line of the High-level Lock Canal (85'), the location of locks and dams.

4th. The mean water-lever and the bottom line of the Straits of Panama.

Excavation actually made by the French companies —60,000,000 cubic metres or 80,000,000 cubic yards,

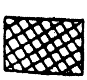


approximately (including deviations), (of which about 9-10ths resulted from the works of the old Panama Company, and 1-10th from those of the new Panama Company), the works of the old company having been accomplished within eight years, including more than two years for the first surveys, the opening of the country, the transportation of a plant worth 30,000,000 dol., the erection of houses and hospitals, &c., leaving between five and six years for the works proper, now represented by an excavation of 55,000,000 cubic metres, or 72,000,000 cubic yards.



Excavation to be made to open the High-level (85') Lock Canal (bottom width 200', water depth 42') — total excavation through the central mass, 53,800,000 cubic yards.

Excavation to be made for the transformation, without any interruption of transit, by floating



dredges of the High-level Lock Canal (85') into the Straits of Panama. Bottom width 500', water depth 45' at the lowest tides)—457,00,0000 cubic metres, or 600,000,000 cubic yards (including the volume of excavation of the High-level Lock Canal).

Such excavation would be reduced to 156,000,000 cubic metres, or 205,000,000 cubic yards, if the transformation would simply aim at the creation of the narrow, shallow, Tide Locked Sea-level Canal, usually termed the Sea-Level Canal, which, if constructed immediately by the usual methods of excavation, steam shovels on rail, and railroad transportation of the spoils to the dumps, would require for the opening of transit a period of time about equal to the sum of the two periods necessary first for building the High-level Lock Canal, and second, for transforming it into the Straits of Panama.

C.—*Plan of the Panama High-level Lock Canal (summit elevation 130'). Constructible in four years (first phase) in order to be later transformed into the "Straits of Panama" (second phase) without interfering with navigation.* (Bunau-Varilla project of 1905). (See p. 252.)

NOTE.—This plan is the same as for the lock canal at elevation 170', only two more locks have to be added. It has appeared unnecessary to make a special plan for the particular project, the location of the locks being shown in the longitudinal sections.

D.—*Longitudinal Section of the Panama High-level Lock Canal (summit elevation 130'). Constructible in four years (first phase) in order to be later transformed into the "Straits of Panama" (second phase) without interfering with navigation.* (Bunau-Varilla project of 1905). (See Supplement.)

NOTE.—The governing ideas of the conception of the high-level lock canal at elevation 130' is 1st, to reduce to the minimum the amount of excavation of the central cut so as to be sure to dispose of it in 4 years, without too much elevating however the summit. 2nd, to reduce as much as possible the height of the dam at Bohio. In this plan the head of water is reduced to a maximum of 60' above the sea, the level of the ground of the valley being 30' above the sea, and the bed of the river being at sea-level.

The method proposed by M. Bunau-Varilla for erecting this easy dam and which was so unhappily applicated by the minority of the Consulting Board for the Gatun dam, consists in bringing, in scows, dredged material from the neighbourhood to the site of the dam and to pump it on the dam location. The ground is excellent at Bohio, very bad at Gatun. The length of the dam at Bohio (1285' at the crest) is about six times smaller than at Gatun, and its height above the bed about half the height of the Gatun dam. 3rd, the lock canal being temporary the locks can be smaller than in a perpetual lock canal.

The longitudinal profile of the Panama route shows:—

1st. The original natural ground along the axis of the canal.

2nd. The lowest point reached by the excavation in every cross-section. (Between this lowest point and the original natural ground the cut is entirely open, but necessitates in most places widening.)

3rd. The water level and bottom line of the High-level Lock Canal (130'), the location of locks and dams.

4th. The mean water-level and the bottom line of the Straits of Panama.

Excavation actually made by the French Companies.

(See note to Diagram B.)

Excavation to be made in four years to open the High-level (130') Lock Canal (bottom width 150'—water depth 35')—total 45,000,000 cubic metres or 60,000,000 cubic yards approximately, of which 20,000,000 cubic yards only are to be excavated in the central cut, making necessary a total yearly output (15,000,000 cubic yards), inferior to that reached by the old company (16,000,000 cubic yards).

Excavation to be made for the transformation, hout any interruption of transit, by floating dredges of the High-level Lock Canal (130') into the Straits of Panama, (Bottom width 500', water depth (45' at the lowest tides)—457,000 cubic meter. or 600,000,000 cubic yards (including the volume of excavation of the High-level Lock Canal).

E.—*Longitudinal Section of the Panama High-Level Lock Canal (summit elevation, 170'), constructible in three years for a limited traffic such as that of military navigation, in order to be later transformed into the "Straits of Panama," without interfering with navigation.* (See Supplement.)

NOTE.—It is the Bunau-Varilla project of 1905 modified in view of reducing to the lowest limit the works necessary to the opening of interoceanic communication, and therefore the time necessary.

The governing ideas of this project are the following:—1st. In order to eliminate the time necessary to open a cut through the summit, the water is raised high enough to form a continuous level which dredges will widen and deepen, or to reduce the work in the dry to an insignificant amount if it is thought preferable to dig during the erection of the locks. 2nd. In order to eliminate the major part of the time necessary for the masonry of the locks, it will be limited to the heads of these works, the slopes of the cuts will limit laterally the body of the locks. 3rd. The outlet of Lake Bohio will be opened through the canal cut laterally to the locks. 4th. The locks will be single and sufficient for the largest men-of-war. 5th. In order not to wait until the dam at Gamboa is erected, a steam pumping-station will be established near Gamboa to feed the summit level for the limited traffic referred to during the dry season, and help the Obispo River during the wet one.

This conception would correspond to the opening of navigation for military purposes during the executions of the Straits of Panama by dredging, and would greatly facilitate the works by giving free access to the plant from the sea to the summit level.

The longitudinal profile of the Panama route shows:—

1st. The original natural ground along the axis of the canal.

2nd. The lowest point reached by the excavation in every cross-section. (Between this lowest point and the original natural ground the cut is entirely open, but necessitates in most places widening.)

3rd. The water-level and bottom line of the High-level Lock Canal (170'), the location of locks and dams.

4th. The mean water-level and the bottom line of the Straits of Panama.

Excavation actually made by the French companies.

(See note to Diagram B.)

Excavation to be made in three years to open the High-level (170') Lock Canal (bottom width 150', water depth 35').

Excavation to be made in 10½ years for the transformation, without any interruption of transit, by floating dredges of the High-level Lock Canal (170') into the Straits of Panama. (Bottom width 500,' water depth 45' at the lowest tides)—450,000,000 cubic metres or 600,000,000 cubic yards (including the volume of excavation of the High-level Lock Canal.)

F. — *Installation of Dredging Works made at Culebra (Pacific slope) in* 1888 *by M. Bunau-Varilla, about* 18 *metres,* 60 *feet above the Rio Grande river.* (See p. 268.)

NOTE.—Owing to the lack of water communications, which then were not easy to establish with the projected Lake of Gamboa, the spoils were then dredged again and sluiced into the Rio Grande valley. This was temporary. It was intended to remove by railroad transportation the redredged material until the water communication could be established with the Gamboa Lake. This precious installation was blindly abandoned by the new Panama Company and the floating plant put aside. It astonished very much the American engineers to find naval plant on the top of the Culebra cut. "What man does not understand," said Goethe, "he makes fun of." The Secretary of War, Taft, materialized this thought of Goethe when he said to a Committee of the House: "Mr. Stevens, the Chief Engineer, has got a launch which was found on the top of the Culebra cut, that he took down from there, and had repaired, and is now using at La Boca. They (meaning the French) apparently thought the water was coming up the top of the cut and they would get the launch there in time."

G.—*American Steam Shovel At Work.*

It is to this type of steam shovels that the American opinions attributed erroneously the future solution of all excavation problems. (See p. 264.)

The American engineers have been led to recog-

nise that the difficulties of the Isthmus are entirely in the transportation, and not in the loading of the material. (This photograph is extracted from the message of the President of the United States, December 17th, 1906).

H.—*View of an Excavation in the Culebra Cut.* (See p. 266.)

NOTE.—This picture is extracted from the Panama message sent to Congress on the 17th of December, 1906, by President Roosevelt, on his return from the Isthmus.

This picture appears in the message with this line below: "View in Culebra Cut. The level at which the two men are standing is that reached by the French; the level at which the motor-car stands is the present American level—65 feet below."

Everybody reading the message cannot help believing that a new level 65 feet below the lowest, left by the French across the Culebra Cut (seven miles long) has been excavated by the Americans.

There is, unfortunately, not the shadow of a reality in such a belief which the line below the picture above necessarily creates. President Roosevelt must have been deceived by some false explanation, otherwise he would not have inserted such a statement in a public document bearing his respected name.

For the necessities of railway communications, the Panama Company had left a short mass of ground (200 to 300 yards long) 33 feet above the general level they created at 157 feet (48 metres) through the Culebra Mass, originally 333 feet high above the seaon the axis, and 300 at the lowest point of the saddle. This small mass of ground has been removed by the Americans. It has the importance of the removal of a railway embankment. It is not the creation of a new level. Nothing else can give the colour of reality to the phrase reproduced above. The report of the Isthmian Canal Commission for the year ending December 1st, 1906, says:—"The engineering work of the year has been almost entirely preparatory. . . . . . The general plan of the work which has been done in the Culebra Cut has been in putting the various levels in proper conditions for the maximum number of steam shovels." Such capital work, then, as the creation of a new level 65 feet below the level reached by the French, has never been made.

I.—*Twelve-ton Lobnitz Rock Cutter working in the Manchester Ship Canal,* (from *Engineering*, August 17th, 1906, kindly lent by the editor of *Engineering*). (See p. 248).

NOTE.—The average cost in ten months, of operating this machine for loosening the rock and transforming it into a material as easily dredgable as sand was 8·94 pence per cubic yard in spite of the interruptions of the works by the ships. (Figures given by Mr. Hunter, chief engineer of the Manchester Ship Canal.)

J.—*Comparative Cross Sections.* (See p. 240.)

The hulls represented in the drawings above are those of the new Cunarders, *Mauritania* and *Lusitania*. Their beam is 88 feet, their draught of water 36 feet. They would pass the "Straits of Panama" with 9 feet below the keel at the lowest stages of the tide, and with ample room to cross each other. They could not pass the Panama sea-level canal for want of depth, and they could not cross each other if they had the necessary depth. This was partly remedied by the Consulting Board. The majority gave 40 feet depth, and the minority 42 to 45 feet depth to the canal. In both cases the cut at Culebra, 200 feet wide, does not allow the crossing of such ships.

NOTE.—The two cross sections correspond to the average altitude of the ground on the axis in the Culebra cut, 181′ $\frac{7}{10}$ (55 m. 43.). The depth of water in the "Straits of Panama" is the average depth at mean tide in the Culebra cut.

The time of construction by wet process of the "Straits of Panama" is estimated at 15 years, the expenditure is estimated at £30,000,000. The excavation is estimated at 600,000,000 cubic yards.

The time of construction by dry process of the "sea-level canal" is estimated at 22 years, the expenditure is estimated at £60,000,000 by the Isthmian Canal Commission, the excavation is estimated at 205,000,000 cubic yards.

K.—*Works in the dry (Culebra) as they were installed in* 1888 *(looking towards Panama) by the old Panama Company (de Lesseps Company).* (See p. 244.)

L.—*Reservoir on the high Rio Grande, created in* 1888 *by M. Bunau-Varilla for feeding the dredging pond he installed on the slope (Pacific side) of the Culebra Saddle, and which is represented in drawing F.* (See p. 269.)

This reservoir has been used by the Americans 16 years later to feed the town of Panama with drinkable water.

M.—*Works in the wet. Dredge working in Blasted Rock,* 1888. (See p. 245.)

NOTE.—After M. Bunau-Varilla removed in 1885 rock under water at a moderate price (8 francs a.c.m.), the contractor in charge of the Mindi Hills preferred drowning the open-air excavation in the rock and attack it by dredge, after mining and blasting it either above or below water. This shows that already in 1887 it was deemed more economical to mine under water the rock and to dredge it, than to excavate and to transport it in the dry. Now, with the electric and large dredges with the Lobnitz cutters, this is ten times more true.

DISCUSSION.

The CHAIRMAN, in opening the discussion, referred to the fact that the author had been connected with the Panama Canal since 1884, at which time he was in co-operation with M. de Lesseps, who was the

prime mover in the starting of the great scheme. The audience therefore had had the pleasure of listening to a gentleman who had had more than usual opportunities of making himself acquainted with the project in general and with the special difficulties which had to be surmounted. All had listened to the author's description of the Panama Canal and the problem which had to be solved with very great interest, and felt that he had given his whole heart to the solution of the problem of the secret of the Straits. The author was an entirely independent gentleman so far as the present undertaking was concerned, and he had come that evening to give to the Society, and through the Society to the world, his well-considered views as to the proper mode, and, in his opinion, the only mode, of bringing the work to a successful issue. He (the Chairman) was afraid that, without more study than one could give to a subject which was abstruse, it was very difficult to express any opinion on the author's views, but in principle one could not help being captivated with the idea that the work could be constructed and brought to a proper issue by the use of water as the carrying power for the machinery to do the excavation, and as the carrying power for the transport of the dredged material to its destination. One could not help being struck also with the great ingenuity by which a large receptive place could be made where the dredged material might be deposited, at a level which was sufficiently convenient for the barges to reach. The mode of carrying out the work as described by the author, the number of barges which would have to be employed, the number and the size of locks which would be necessary in order to perform the work in any given time, and the quantity of material which would have to be transported were matters of careful calculation for the engineers, with which the present meeting had nothing to do. The broad principle commended itself to an engineer at once, that if it was possible to use the flotation power of water to bring the excavators to the place where the excavation had to be made, and if it was also possible to take the barges from the dredger to the place for which they were destined, it would solve some of the greatest difficulties of dealing with such a work in such a country. As the author said, instead of treating the great rainfall as an enemy, he converted it into a friend and an ally; and if that plan could be carried out, it seemed to him a most valuable suggestion. His own experience went to corroborate these views entirely, because he very well knew the cost of excavating in waterlogged strata when the excavation was made in the dry, where the rain caused innumerable slips of earthwork and occasioned the greatest difficulty in maintaining the roads. If these difficulties could be avoided, an enormous amount of trouble was done away with, and a price was reached which was far and away less than anything which could be contemplated for excavation in the dry. He supposed one might almost say that the Suez Canal would have been impossible of construction if it had not been for the great improvement in dredging plant which took place about the time that the problem had to be undertaken, although in that instance the distances to which the earth had to be transported were comparatively short. Since that time the development of dredging plant had gone on by leaps and bounds, and engineers were now able to use dredgers supported by water at the spot where the work had to be done of a power and celerity of excavation which were never dreamed of in former years. All those developments had taken place within the memory of those present, and they were not yet at an end. The only point which struck him adversely in the paper was where the author talked of excavating with dredgers which were 16 years old. He thought the author in that instance could only have been referring to an experimental excavation because personally he should be very sorry to undertake to go on with the Panama Canal with dredgers built 16 years ago when he could now obtain dredgers of a very superior character and of much greater power. He had had something to do with the Suez Canal, and could speak from experience with regard to the question of the excavation of rock under water. Mr. Quellennec the consulting engineer of the canal, knew the price of the work much better than he did, but the matter was brought before him while he was a member of the International Consultation Commission on the Suez Canal. It was at one time considered that the excavation of the rock between the Bitter Lakes and Suez for the purpose of deepening the canal to suit the modern requirements of ships presented such a serious obstacle that the work was suspended for many years, although everybody knew it would have to be done. But that difficulty disappeared. The work was done without explosives, the traffic of the canal was not interrupted, and the price at which the excavation of the rock under water was done was given by Mr. Quellennec at 1s. a yard. Mr. Hunter had also stated that he excavated the rock in the Manchester Canal under water by the same Lobnitz process at 9d. per cubic yard; and those prices engineers must take as facts. Taking those prices as true (and they must be so considered on the evidence of such eminent engineers) it did seem a very startling proposition that engineers should be contemplating at the present time such a very large price for the Panama Canal as 10s. a cubic yard for rock excavation. He also desired to say that he could, more or less, corroborate from his own knowledge the prices the author had quoted for the dredging of soft material. He had excavated and removed to a distance many millions of yards of such material; and in addition to that engineers were now, under more modern principles, excavating material and pumping it for half a mile or 1½ miles through large pipes without the least difficulty and at a very moderate price. That again showed how very much could be learned when one had to deal with a dredging system compared with an excavation system. The grandeur of

the author's conception struck him at once as one which all would like to see completely considered. Although the cross section of Panama Canal, as proposed by the Commision, was much larger than the Suez Canal, it was comparatively small in view of the constant augmentation of the size of ships, and he thought it would be found that the Isthmian Canal was already doomed as too small for the requirements of the future. He, therefore, thought everyone would welcome the idea which the author had enunciated, that they need not be content with what one might call a canal but look forward to what had been better described as the Straits of Panama. Another thing which struck him was that the recent sad experiences which had taken place at Jamaica, Valparaiso, and California seemed to indicate that a great work of international importance in such a locality as Central America and the Isthmus of Panama ought, if possible, to be so designed that what were called works of art should be altogether avoided. A system of a lock canal in a volcanic neighbourhood subject to earthquakes could not be looked forward to with complacency; and when the enormous amount of money which was to be spent on the work was taken into consideration, it seemed to him as an outsider—because he was only an outsider in this particular matter—that anything in the nature of large masonry dams and locks closed with gates, which would be absolutely wrecked by comparatively small shocks of earthquake, should be avoided in such a magnificent undertaking.

Mr. E. W. MOIR said he did not know much about the Panama Canal, but he could fully endorse the author's statements with regard to the advantages of dredging as against excavation in the open, and also the increased power of modern dredging plants compared with what was possible within comparatively recent times. His own firm of S. Pearson and Son had extensive dealings in dredging plant, and only in the previous week placed with Messrs. Lobnitz an order for a dredger which was guaranteed to put out over a thousand yards an hour from a depth of 45 feet in soft ground. The buckets were of a cube capacity of one metre, and guaranteed to travel at the rate of 18 buckets per minute. He had often had conversations with Mr. Lobnitz about his rock-breaker. Mr. Lobnitz's father began the work of building dredging plants on the Clyde, and the son was ably carrying on the work in his father's footsteps, and told him that quite recently he had seen figures of the Manchester Ship Canal costs which indicated that sub-aqueous rock dredging was being carried out at a smaller figure than it was possible to take out the same rock with ordinary boring and explosives on the surface. That evidence, therefore, conclusively confirmed what the author had said. He thought the reason the Americans had decided on the lock canal system was largely due to their desire to have the canal pushed through within the memory of the present generation. While the International Commission exclusively reported in favour of the sea-level canal, although of course on a much smaller section than that suggested by the author, they felt that it would take too great number of years to make. His firm was very interested in the Isthmus of Panama, and Sir Weetman Pearson was only on that very day opening the Tehuantepec Railway, and the connecting harbours. For the last eight years, Sir Weetman had been erecting a railway across the Isthmus of Tehuantepec, and building two ports, one at Coatzacoalcos, on the Gulf of Mexico, and the other at Salina Cruz on the Pacific, which would give from the present day a communication of much less distance than anything now existing, or that would exist even after the Panama Canal was completed. The distance between New York and San Francisco was 1,000 miles less than it would be between the same places by the Panama Canal when completed, although the railway was only 192 miles long. His firm were in partnership with the Mexican Government in the control and working of the railway, and they expected great things for international trade. One line of steamships, instead of going round the many thousands of miles *viâ* Cape Horn, had arranged for its freight to pass over the Isthmus; and, due to the fact that Americans were wise enough to insist that all coast trade should be carried in American bottoms by American seamen, a very large sum of money had been invested in ships under the American flag to carry the freight from New York to San Francisco.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Bunau-Varilla for his interesting and instructive paper.

Mr. BUNAU-VARILLA, in reply, remarked that reference had been made to the enormous strides which had taken place in water-borne excavation compared to earth-borne excavation. Outside of those due to the enormous increase in the size and power of the dredges, there is another which will play an important part in Panama—the use of electricity. On board a dredge, the actual cost of the dredging lay not so much in the work done as in the time lost and the occurrence of accidents. As dredges are excavating material they cannot see, they are exposed to hidden obstacles, and abnormal resistance is from time to time imposed upon the machinery. But when the motive power is electric, as soon as the resistance comes to a fixed limit the current stopped and the accident avoided. That is a very important factor in the cost of the work. In 1895, while he was constructing a railway in the west of Spain, he took advantage of having to remove a large quantity of ballast from the river Esla to make experiments with regard to the adaptation of electricity to dredging, and they entirely fulfilled his

expectations. The employment of electricity on board a dredge led to a considerable economy in time by the prevention of small accidents. He could not conclude without expressing his deep gratitude for the hospitality which had been shown him by the Society of Arts. The hall of the Society was a most suitable place in which to state his opinions, because it was neutral and friendly, and situated in a country which was closely linked with his own by ties of the deepest friendship.

THE RAILWAY AND TRAMWAY SYSTEMS OF JAPAN.

The first Government railway built in Japan was that between Tokyo and Yokohama—eighteen miles—which was opened in 1872. From that time the Government made every effort to construct more lines, until, by the financial year 1882-3, 150 miles had been completed. The railway was at the time generally looked upon as a Government undertaking, and no attempt was made among the general public to engage in railway enterprise. In 1883, however, a private company was for the first time formed for the construction of railways, and thereafter railway enterprise made gradual progress among the people. In 1887 the Private Railways Regulations were issued, and both Government and private railways increased and grew rapidly in prosperity. At the present time private lines have, in mileage, left the Government lines far behind. In March, 1900, the Private Railways Law and the Railway Traffic Law were promulgated, thereby completing the legislation, private and public, in respect of railways. In March, 1905, the Railway Mortgage Law was issued with the approval of the Imperial Diet, and opened the way for the circulation of capital, for this law enables a private railway company to form a railway foundation with the whole or part of its railway lines, land for railway use, buildings, machinery and appliances for railway use or appertaining to the railway, and rolling-stock and appliances appertaining thereto, and make such foundation the object of a mortgage right. The principle of railway nationalisation first took effect in Japan when railways were projected between Shimbashi and Yokohama, and Kyoto and Kobe, and in 1892 was established the Railway Construction Law, which mapped out the important lines throughout the country, and indicated the general plan of working such lines by means of railway loans. Before, however, this law was passed, it had been decided that it would, for the purpose of effecting a speedy construction of railways, be best to leave such construction to private enterprise, and in 1887 the Private Railways Regulations were issued. Since then Government and private lines have extended side by side. At the present time, in view of the necessity for a definite post-bellum programme and for the increase of national wealth and development of national resources, it has, according to a recent report of the Japanese Ministry of Finance, become of the utmost importance to introduce effective means of internal transportation and communication. In addition to the Government lines, there are more than thirty private railways, and even the principal trunk lines running from Hokkaido to Kyushu are under the control, some of the Government and others of various private companies, so that the traffic on them lacks order and uniformity. For these reasons the Japanese Government decided upon the State ownership of all railways that are used for general traffic, leaving out those of merely local importance, and proposed to purchase the lines belonging to thirty-two private companies within a period extending from 1906 to 1911, and the Seoul-Fusan Railway in 1906. Accordingly the Railway Nationalisation Bill and the Seoul-Fusan Railway Purchase Bill which embodied these plans, were presented to the Imperial Diet, and were duly passed, with an amendment made in the House of Peers, by which the number of companies to be bought out was reduced to seventeen, and the period of purchase extended. The lines to be purchased under the Railway Nationalisation Law are those belonging to seventeen companies, namely, the Nippon, Sanyo, Kobu, Kwansai, Kyoto, Hankaku, Hokuyetsu, Nishinari, Nanao, Ganyetsu, Kyushu, Hokkaido-Tanko, Hokkaido, Sangu, Sobu, Boso, and Tokushima, all of which are main trunk lines used for general traffic. Their aggregate length is 2,812 miles, and cost of construction about £23,463,000. The Government is to purchase the above-mentioned railways within a period of ten years from 1906 to 1915. The purchase price is to be calculated in the following manner:—(*a*) An amount equal to twenty times the sum obtained by multiplying the cost of construction at the date of purchase by the average ratio of the profit to the cost of construction during the six business terms of the company from the second half year of 1902 to the first half year of 1905; (*b*) the amount of the actual cost of stored articles converted according to current prices thereof into public loan bonds at face value, except in the case of articles which have been purchased with borrowed money. The first electric tramway built in Japan was a line eight miles in length opened in Kyoto in 1895, when a national industrial exhibition was held in that city. Since then, other cities of importance have in succession constructed electric tramways as convenient means of communication for short distances, so that there are now eighteen electric tramway companies, with an aggregate capital of £3,891,000, whose lines already opened total 130 miles, with 82 miles in addition under construction. Most of the companies, however, are still in the initiatory stage and do not yet make a very profitable business of the undertaking. That the profits will be large, however, is clearly shown by the fact that the electric tramways of Tokyo already pay annual dividends of not less than 10 per cent.

HOME INDUSTRIES.

The Growth of British Trade.—Naturally there has been much congratulation over the Board of Trade figures which show that the export and import trade of the United Kingdom in 1906 amounted to £1,069,000,000, exclusive of bullion and specie, the increase in the export trade, as compared with that of 1905, being 13·6 per cent., and in imports of 7·4 per cent., but there cannot be full appreciation of these figures without showing among other things—(1) the effect of the rise in prices, (2) the condition of home trade, (3) the trade expansion of other countries for the year. With regard to values, Mr. Sauerbeck has published a memorandum in which he arrives at the conclusion that the rise in wholesale prices in 1906 in the United Kingdom was 6·8 per cent. According to the Board of Trade figures the increase of imports into the United Kingdom in 1906 was 7·4 per cent., of which 5·3 per cent. represent increase in values, so that there was only an increase of 2·1 per cent. in quantities. Again, with exports, the increase of 13·6 per cent. given by the Board of Trade falls to 8·3 per cent. if the increase in values is deducted, and the increase of 10 per cent. in the values of total trade becomes a trifle under 5 per cent. in quantities. Even the smaller figures show not unsatisfactory expansion of trade. Of course, the condition of home trade is a most important factor in appraising the general condition of trade. There may be growth of exports due to stagnation of home markets, and in that case, or if the growth is accompanied by a growth of imports in the manufacture of which there is a larger percentage of labour than in the manufacture of exports, it would not be a proof of national prosperity. Unfortunately at present, the data are wanting to enable a sound conclusion to be arrived at as to the condition of home trade, but it is to be noted that imported manufactures increased 1·7 per cent. in 1906, as compared with 1905, while exported manufactures increased 7·9 per cent., the growth in the exports of manufactures being practically equal in ratio to the growth of exports in all classes combined. Turning to our chief commercial rivals—the United States, Germany, and France—there are no available estimates of the change in price in these countries, but the increase in the import and export trade of the United States was 11 per cent., of Germany 12½ per cent., and of France 7 per cent., as compared with the 10 per cent. of the United Kingdom. Taking exports only, the increases were—the United States 12·2 per cent., Germany 9·7 per cent., France 5·3 per cent., as compared with the 13·6 per cent. of the United Kingdom; and turning to imports, the United States show an increase of 10 per cent., Germany of 14·9 per cent., and France of 9·1 per cent., as compared with the 7·4 per cent. of the United Kingdom. It may be assumed that the effect of the rise in values has been at least as great in these three foreign countries as in Great Britain, and so much is said about the expansion of German trade, that many will note with surprise that whilst German imports show a much larger increase than those of the United Kingdom, an increase which may be taken to be due in considerable measure to the growth of food imports, German exports increased only 9·7 per cent. as against the 13·6 per cent. of the United Kingdom. Looked at from any point of view the trade figures would seem to prove that in 1906 the United Kingdom more than held her own in the trade of the world. But it will be well to bear in mind that the upward trend of trade cannot go on indefinitely A movement in the opposite direction must come, and whilst present indications suggest that probably it will not come this year, the outlook in the United States suggests misgivings.

Southampton and Liverpool.—The migration of the steamships conducting the mail service of the White Star Line from Liverpool to Southampton is a noteworthy event in the North Atlantic shipping trade. It is contended that the explanation of the change is, any way in part, the desire to meet the growing demand of travellers that facilities shall be provided to enable them to embark and disembark at either a Continental or a British port. The White Star vessels will sail from Southampton on Wednesdays, and will then call at Cherbourg and Queenstown. On the return journey they will call at Plymouth then Cherbourg, terminating their journey at Southampton. The change does not mean that the connection of the White Star Line with Liverpool has terminated. Not only will the weekly passenger service be maintained by the *Baltic*, *Celtic*, *Cedric*, and *Arabic*, but the Liverpool and Boston passenger service, the Australian service, and the regular weekly services of live-stock and cargo steamers will be maintained as heretofore. But the loss to Liverpool from the transference of the *Oceanic*, *Majestic*, *Teutonic*, and *Adriatic*, to Southampton will be considerable, and it comes just as the Mersey Docks and Harbour Board have made immense efforts to adapt the port of Liverpool to the most modern requirements. It is understood that it is not the present intention of the Cunard Company to go to Southampton, and if they go to a Channel port it may be to another than Southampton, which will have quite enough to do for the present in providing the accommodation required by the monster steamers of the White Star Line. Probably the Cunard Line will prefer to remain at Liverpool, where they have secured practically the whole of the large increase which took place last year in the passenger traffic between Liverpool and New York. But a good deal may depend upon what becomes of the proposals with regard to the basis upon which dock tonnage rates are levied, which are contained in the Bill to be presented to Parliament by the Mersey Dock and Harbour Board. At present these dues are levied on the net tonnage. The Bill proposes that they shall be levied on a proportion of the gross tonnage. To this the Cunard Company is strongly

opposed, believing it would seriously handicap the large mail steamers in which there is a marked disparity between the gross and the net tonnage. But it is quite possible that Parliament will reject the proposals of the Board, seeing that a Committee of the House of Commons has reported against them upon the ground that they would only affect a small percentage of tonnage, and that consequently it is not worth while altering the existing arrangements, more especially as such alterations might lead to international complications.

The Cotton Industry in 1906.—The Board of Trade returns show that 1906 was a very prosperous year for the cotton industry, and the *Economist* summarises the facts and figures in a very interesting article. The cotton piece-good shipments of the year show an increase in yardage, as compared with 1905, as from 6,196,783,900 to 6,261,295,000. Last year's shipments of bleached and grey cloths were less than in 1905, the increase being in printed and dyed goods. The largest increased takings were by Turkey, 102,744,000 yards, the Argentine Republic being a far behind second with an increase of 33,804,000 yards. Throughout the year makers were busy at a fair profit which, however, was less in the latter half of the year, owing to the abnormal rise in American yarns. Users of Cop twist and weft had to pay much higher rates, and could not get a corresponding advance in cloth. The year shows substantial profits on capital employed, but as in 1905 the gain was larger in weaving than spinning. Home made goods were active in nearly all descriptions, and the distributing houses were busy throughout the year. Many new looms were put down in 1906, and more projected. The estimate for the last two years is 80,000. As the new weaving sheds got to work there sprung up a good demand, and by the middle of the year there was almost a scarcity of yarn. Although the production was larger owing to the starting of new factories, it was fully absorbed all through the last six months of the year. Shipments of yarn were larger, 207,373,100 lbs. as against 205,100,500 in 1905, the Netherlands showing the largest increase in taking 2,310,000 lbs., Japan coming close with 2,244,000, and Germany third with 1,501,000 lbs. The price of raw American cotton fluctuated considerably, being at its lowest point in August, when 5·29d. was the rate, and highest in October at 6·45d. per lb., the average price in Liverpool being 5·95d. per lb. as compared with 5·09d. in 1905. The crop of the year ended August amounted to 11,319,000 bales, the best expert opinion putting the crop of the current year at 13,000,000 bales. During the last eighteen months 18 new spinning mills, with 1,627,355 spindles, using Egyptian cotton, have got to work, seven new mills with 595,000 spindles have partly commenced, and 14 new mills with 1,440,000 spindles are being erected. Of new mills spinning American cotton, fifteen, with 1,265,000 spindles, have during the same period been got fully to work; eleven with 1,002,000 spindles have got partly to work, thirty-one with 2,561,000 spindles are in course of erection, and three with 300,000 spindles are projected. Taking the net profit and loss of the spinning trade since 1884 a larger profit was made in 1906 than in any year of twenty-three except 1905. As to the outlook for the present year it remains to be seen whether the great extensions in the spinning and weaving departments will be met by the demand, but on the whole probabilities point to another prosperous year, if only the present amicable relations between masters and men continue.

Electricity in Cotton Mills.—Mention has been made from time to time in these Notes of experiments in the electric driving of cotton mills. The first electric-driven mill in the United Kingdom was started in Scotland three years ago, but they have been known in South Carolina for the last fifteen years. The Lancashire mill owners who have adopted the electric drive say they are satisfied with it. The systems adopted are either the arc unit or the group system, but the two may be to some extent combined by forming small groups. There is an absence of speed variation in cotton mill machinery which would seem to make such plants specially adapted for electric driving. As a writer in the *Manchester Guardian* has pointed out the actual horse-power required to work each machine is not generally known with sufficient exactitude, so that the electrical engineer is obliged to make tests in order to properly apply the system to be adopted. If electric driving fulfils the expectations of its friends it will no doubt be installed in existing mills as this can easily be done without causing a stoppage of work. The experiments now being carried out to test the comparative value of electric driving systems will be watched with keen interest.

A New Insurance Departure.—The inclusion of domestic servants in the Workmen's Compensation Act means a great accession of business for some of the insurance companies, and will find work in canvassing for many new hands, among whom, it may be expected there will be a considerable portion of women. For the well-to-do, the burden of insurance will be infinitesimal. Already the rates vary considerably, but in no case that the present writer has seen are they large. Policies are offered to cover the mere legal liability of domestic servants at 3s. per servant, and others, which not only give complete protection against strict legal obligations, but will enable employers to carry out moral obligations they may feel towards those in their service, at 5s. per servant.

CORRESPONDENCE.

PATENT-LAW REFORM.

After reading the recent interesting paper and discussion on the above subject, it was the intention of the writer to contribute a word or two by way of

emphasising a suggestion made by one of the speakers from an inventor's standpoint, but what he intended to say has been so fully anticipated in the letter sent by Mr. Hardingham, that further remarks are scarcely necessary.

Those who have had long experience relating to inventions and patents, know that in order to get the merits of a good patent duly appreciated, several years are often consumed in the process.

The initial stage of the proceeding is often done without remuneration and sometimes at a loss. Generally speaking it is only at the fag end of the lifetime of the patent that a fair remuneration is realised by the inventor or patentee. Under these conditions the time limit of a good patent should not be a bit less than 18 years; this would give more encouragement to the inventive faculty.

The premium for renewing should be placed within the reach of most moderate means, say much about the same cost of securing a patent for the United States of America.

It is hoped that the promoters and drafters of the new Bill will not lose sight of the injustice with which the English inventor has to combat against, the prohibitive conditions and tariff which bar in a great measure an English inventor and patentee from selling his patented goods in a foreign country, while the foreigner can import and sell his patented articles in the United Kingdom free of rates, taxes, and other expenses. This should not be allowed to continue.

ISAAC SMITH (of Sydney Smith and Sons).

Basford Brass Works, Nottingham.
Jan. 20th, 1907.

OBITUARY.

THOMAS SEBASTIAN DAVIS. — Mr. Sebastian Davis, who had been a member of the Society of Arts since 1882, died on the 30th December last, at the age of 78, having been born at Kennington, in 1828. He was a very early member of the Photographic Society, which he joined in 1857; was a very constant attendant at its meetings, and for many years served on its Council. He always took a great interest in photographic progress, and was himself—especially in earlier years—an ardent experimentalist. He was a Fellow of the Chemical Society, and an original member of the Society of Chemical Industry. By profession he was an analytical chemist. Mr. Davis was a frequent attendant at the Society's meetings, and occasionally took part in its discussions.

GENERAL NOTES.

THE TRADE OF MOROCCO.—The Anglo-French Agreement has been followed by great increase in French trade with Morocco, mainly at the expense of the United Kingdom. There has been a large influx of Frenchmen into Morocco, the number of French residents, exclusive of Algerians, being now probably treble what it was three years ago. Important French banks have been established at Tangier, with branches at the other ports, and French firms have established houses of business at the towns of the interior as well as at the ports. The French Government has also granted subsidies to steamship companies to run mail steamers to Tangier at regular dates, thus increasing French shipping and giving greater facilities for trade with France and Algeria. In his report on the trade of Morocco, just issued (Cd. 2682), Mr. Consul White gives tables which show that the percentage of exports to the United Kingdom from Morocco fell from $28\frac{3}{4}$ in 1904 to $24\frac{7}{8}$ in 1905, whilst those to France increased from $22\frac{7}{8}$ per cent. to 32 per cent, and the imports from the United Kingdom have in the same period fell from $50\frac{3}{8}$ per cent. to 36 per cent., whilst those from France increased from $31\frac{3}{8}$ per cent. to $43\frac{3}{4}$ per cent. The United Kingdom has pretty well maintained its position as to shipping, the decrease being only from $34\frac{7}{8}$ per cent. to $33\frac{5}{8}$ per cent., but France has increased her percentage from 21 per cent. to $29\frac{7}{8}$ per cent., mostly at the expense of Germany, Spain, and Italy.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

JANUARY 30.— "Apprenticeship." By JAMES PARSONS, M.A. SIR WILLIAM BOUSFIELD, M.A., LL.D. will preside.

FEBRUARY 6.—"The Principles and Practice of Insurance, and their modern Developments." By THOMAS EMLEY YOUNG, B.A, Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association.

FEBRUARY 13.—"Motor Omnibuses." By LORD MONTAGU OF BEAULIEU.

FEBRUARY 20.—"Cold Storage and Food Supply." By HAL WILLIAMS.

FEBRUARY 27.—

MARCH 6.—"The Discovery of the South Eastern Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 14.—"The Practical Side of Famine in India." By SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., late Chief Commissioner of the Central Provinces.

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

JANUARY 29.—"Artistic Treatment of the Exterior of the Pianoforte." By WILLIAM DALE, F.S.A. T. G. JACKSON, R.A., will preside.

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. This paper has been unavoidably postponed from February 19th.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

LECTURE I.—JANUARY 28.—*Alluvial Gold Mining.*—Small scale methods and manual appliances—Hydraulic sluicing — Gold dredges; chief types; ground to which suitable; costs—The deep leads of Australia; their nature; distribution; methods of discovery and mining.

LECTURE II.—FEBRUARY 4.—*Lode Mining.*—The term "reef" used both for ore and "country" rock—The chief types of gold-bearing lodes—The importance of ore genesis in reference to mine development—The chief gold fields of the world and their structures—The Rand and its banket.

LECTURE III.—FEBRUARY 11.—*Gold Production.*—The crushing of the ore; the stamp mill—The extraction of gold by amalgamation; smelting; chlorination and cyanidation—Reforms in consequence of the tube mill and the filter press—Tube mill *versus* pan—Proposed abolition of the stamp battery—The depth of ores; surface and secondary enrichment—Mining costs and gold mining organization.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JAN. 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. John Walter Gregory, "Gold Mining and Gold Production." (Lecture I.)

Farmers' Club, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Mr R. Orlebar, "The Report of the Agricultural Committee on Tariff Commission."

East India Association, Caxton-hall, Westminster S.W., 4 p.m. Mr. Nasarvanji M. Cooper, "Prospects of Indian Labour in British and Foreign Field."

Surveyors, 12, Great George-street, S.W., 8 p.m. Dr. Henry Woodward, "The Uses of a Geological Collection."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Major C. D. Bruce, "A Journey through Central Asia to Northern China."

Actuaries, Staples-inn-hall, Holborn, 5 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Professor Sir William Ramsay, "The Transmutation of Elements."

TUESDAY, JAN. 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. William Dale, F.S.A., "Artistic Treatment of the Exterior of the Pianoforte."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. A. C. Seward, "Survivals in the Past from the Plant World." (Lecture I.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. James Tayler Milton's paper, "Internal-Combustion Engines for Marine Purposes."

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W. 4½ p.m. Mr. Edward H. Miller, "Rhodesia and its Resources."

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W. 8 p.m. 1. Discussion on "Osmotic Pressure." 2. The Earl of Berkeley will exhibit and describe his Apparatus for the Direct Measurement of Osmotic Pressure. 3. Mr. W. C. Dampier Whetham, "Indirect Methods of Measuring Osmotic Pressure." 4. Dr. T. Martin Lowry, "Osmotic Pressure from the standpoint of the Kinetic Theory."

WEDNESDAY, JAN. 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. James Parsons, "Apprenticeship."

United Service Institution, Whitehall, S.W., 3 p.m. Lieut.-Col. F. S. Davy, "The Blot on Recruit Training."

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, JAN. 31...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. C. J. Tabor, "Hints on Collecting Old China."

Royal Institution, Albemarle-street, W., 3 p.m. Major Percy Macmahon, "Standards of Weights and Measures." (Lecture I.)

FRIDAY, FEB. 1...Royal Institution, Albemarle-street, W., 9 p.m. Sir Almroth E. Wright, "The Methods of Combatting the Bacteria of Disease in the Interior of the Organism."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "The Palace of Minos."

Geologists' Association, University College, W.C., 7½ p.m. Annual Meeting.

Philological, University College, W.C., 8 p.m.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m.

SATURDAY, FEB. 2...Royal Institution, Albemarle-street, W., 3 p.m. Rev. William Barry, "Papal Deposing Power." (Lecture I.)

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FRIDAY, FEBRUARY 1, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 4, 8 p.m. (Cantor Lecture.) PROFESSOR JOHN WALTER GREGORY, D.Sc., F.R.S., "Gold Mining and Gold Production." (Lecture II.)

WEDNESDAY, FEBRUARY 6, 8 p.m. (Ordinary Meeting.) THOMAS EMLEY YOUNG, "The Principles and Practice of Assurance and their Modern Developments."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, January 28, Professor JOHN WALTER GREGORY, D.Sc., F.R.S., delivered the first lecture of his course on "Gold Mining and Gold Production," the particular subject being alluvial gold mining. The lecturer described the various manual appliances in use—hydraulic sluicing and the chief types of dredges. Also the nature and distribution of the deep leads of Australia. The methods of discovery and mining were described.

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday, January 29, 1907; T. G. JACKSON, R.A., in the chair. The paper read was "The Artistic Treatment of the Exterior of the Pianoforte," by WILLIAM DALE, F.S.A.

The paper and report of the discussion will be published in a future number of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, January 15; COLONEL SIR FREDERICK D. LUGARD, K.C.M.G., C.B., in the chair.

The CHAIRMAN, in introducing the author of the paper, said that Mr. Wilson had spent some eighteen or nineteen years in Uganda, so that there were very few men who had more first-hand knowledge of the country. Mr. Wilson was a very old friend and comrade, having been his chief lieutenant in East Africa during 1889 and 1890. He was very sorry that when he went to Uganda, Mr. Wilson could not accompany him, but he followed shortly afterwards.

The paper read was—

THE PROGRESS OF THE UGANDA PROTECTORATE.

By GEORGE WILSON, C.B.,
Deputy Commissioner, Uganda Protectorate.

INTRODUCTION.

I submit this paper upon the subject of "The Progress of the Uganda Protectorate" with a view to placing before you pictures of two periods in the history of the countries which have ultimately become constituent parts of that Protectorate. The first period will date from the revelation of the mystery which obscured the existence of those regions, a revelation made under the auspices of the Royal Geographical Society by Captain Speke's memorable discoveries in 1860, to that of the historic introduction of authoritative British influence by Captain Lugard under the flag of the Imperial British East Africa Chartered Company in 1890; an era which may be described as the base upon which we have

erected our structure of moral and economic progress. The second period is simply that of the present.

In these two pictures it is my intention to convey to you a clear impression of the beneficent influence which sixteen years of civilising work under British protective dominance has had upon barbarous countries, concurrently with a proper regard being given to Imperial economic considerations. Of these sixteen years four passed under the authority of the British Chartered Company, whose aspirations were patriotic and grandly imperial, but to whose field and scope of exploitation there must of necessity, and from obvious causes, have been some limitations. The remaining twelve years have had the more complete advantage of the sympathetic control of the British Government.

Geographical Situation.

It may lead to an easier grasp of the subject if I at once give a brief description of the geographical position and composition of the Uganda Protectorate in its present complete form. It mostly lies between the 5th degree north latitude and the 1st degree south, with a mean length of 300 miles, and between the 30th and 35th degrees east longitude, averaging in breadth under 300 miles. This area of between 80,000 and 90,000 square miles probably contains about 3,000,000 people, of diverse tribal characters.

Great Lakes.

Situated on the south-east corner of this territorial block is the greatest of the African lakes, the Victoria Nyanza, the existence of which immense sheet of water was a subject of old traditional belief left to be confirmed by Speke's discovery in 1860. Its greatest length is 250 miles and breadth 200 miles, and it is 24,000 square miles in extent. This is a magnificent sheet of water, and is placed next only to Lake Superior in the list of the world's largest fresh water lakes. It is studded with beautiful islands particularly on the west, where there is also an outlet over the Ripon Falls into the Victoria Nile, to which great river it gives birth. At these falls a peculiar reef barrier completely impedes navigation; Sir William Garstin indicates, in his splendid schemes for the regulation of the Nile flow, that it may lend itself to a future barrage scheme for Egyptian irrigation purposes. Though the Falls themselves can be described more as beautiful than grand, having only an actual drop of from seventeen to twenty feet along a distance of about three-quarters of a mile from bank to bank, they offer attractive opportunities for the economic utilisation of hydraulic force. Then running along the extreme western frontier of the Protectorate we have the Albert Edward and Albert Lakes. The former is about 43 miles long by 31 miles wide, and 900 in extent. Then Albert Lake is under 100 miles long by from 18 to 27 miles wide, and covers an area of 1,960 miles. Apart from this group, there is, isolated on the extreme north-eastern boundary of the Protectorate, the Lake Rudolf, 190 miles in length by 20 in breadth, and covering an area of 4,000 miles.

The relative heights of these lakes above sea level is, according to Captain Behren's recent paper—Victoria Nyanza, 3,720 feet; Albert Edward, 3,004 feet; Albert, 1,937 feet; Rudolf, 1,250 feet.

The differences in levels of the Nile series of lakes are accomplished as follows:—From the Victoria Nyanza to the Albert, 716 feet in 250 miles of river way, and from the Albert Edward to the Albert, 1,067 feet in 160 miles; in each case the grade, slight as it is, is affected by instances of falls and rapids.

Some discussion is at times given to the conjecture that these lakes are gradually diminishing. My own observations of the Victoria Nyanza during some years induce me to believe that the lakes are fully susceptible to rainfall. The phenomenal rains of last year have increased the volume of the Great Lake to within an ace of that of the highest visible water-mark, and I think we need have little anxiety that there will be any diminution likely to affect practical schemes within our range of interests.

Ruwenzori Range.

Another physical feature of very special character is the Ruwenzori range of mountains lying between the Albert Edward and the Albert Lakes, and said, after much interesting controversy, to be about 17,000 feet high.

Composition of Protectorate.

I will now enter upon a description of the countries comprising the Protectorate at the present day. For administrative purposes they are classified into five provinces. Of these there are under settled native organisations of government: the Uganda Kingdom, lying on the north-eastern corner of the Victoria Nyanza; the Western Province, con-

taining the smaller kingdoms of Unyoro, Toro, and Ankole, filling the South Western corner and part of the Western Frontier, and abutting on the Albert Edward and Albert Lakes. Under more direct Government control, due to an absence of local cohesive government systems, we have:—The Central Province, comprising Usoga and Mount Elgon and the territory lying between it and the Victorian Nile, in its Western course into the Albert Lake, and the 5th degree north latitude; and, lastly, the Rudolf Province, which holds the countries between Lake Rudolf and the Nile Province. This province is not as yet effectively administered, and will scarcely be more than alluded to in the course of this reading.

The Uganda Protectorate is about 700 miles from the sea coast. Between the two is the East African Protectorate, one quite distinct from that of Uganda, with which we are now dealing. The situation of Uganda was so remote that even when Speke reached the country only a few Arab traders had preceded him, and it is believed that no foreigners had entered the country from the more civilised parts between the time of the arrival of a superior caste some four or five centuries earlier, and the nineteenth century.

Early History.

Having thus located in our minds the position of the countries to be brought under consideration, I will take up the task of depicting the early conditions upon which the tale of progress is to be founded. I have said that up to 1860 the whole of these regions were shrouded in mystery, and that it remained for Speke to lift the veil in 1860 and 1862. He was followed by Stanley in 1875, after which we have a splendid array of names of explorers to aid the compilation of the story of Uganda and the surrounding countries.

The earliest travellers were all greatly impresssed by the barbaric power manifested in the Uganda and Unyoro kingdoms, and particularly with the remarkable organisation which characterised the system of government in Uganda alone of all the Central African countries. They found there full confirmation of the current tradition that some centuries earlier a northern element had entered the country and at once won ascendancy, substituting administerial systems marking a high order of intelligence for the aboriginal conditions common to such countries. A more intellectual stamp of feature distinguished the descendants of this race, being most conspicuous perhaps in the members of the reigning family.

Being anxious to convey accurate ideas, I will solicit your patient hearing of perhaps copious extracts from relations of actual experiences, certain that such first-hand accounts must be more telling than any condensed paraphrasing of mine. In reference to the Uganda "King" Mtesa and his chiefs, and the assertion of the kingly authority, Speke writes:—

"No one dare stand before the king whilst he is either standing still or sitting down, but must approach him with downcast eyes and bended knees, and kneel or sit when arrived. To touch throne or clothes, even by accident, or to look upon his women, is certain death. . . . . . It is the duty of all officers, generally speaking, to attend at Court as frequently as possible. Should they fail, they forfeit their lands, wives, and all belongings. Tidiness in dress is imperatively necessary, and for any neglect in this rule the head may be forfeited."

In recounting his preparations for his reception "at Court" Speke goes on to say:—

"To-day the king sent his pages to announce his intention of holding a levee in my honour. I prepared for my first presentation at Court attired in my best, though in it I cut a poor figure in comparison with the display of the dressy Waganda. They wore neat barkcloths, resembling the best corduroy cloth, crisp and well set, as if stiffened with starch, and over that, as upper cloaks, a patchwork of small antelope skins, which I observed were sewn together as well as any English glovers could have pieced them."

He goes on to describe the dress of the King at this reception in this fashion:—

"Everything was light, neat and elegant in its way, not a fault could be found with the taste of his getting up."

Some twelve or thirteen years later Stanley makes the following allusion to Mtesa:—

"The chief reason for admiration lay, probably, in the surprise with which I viewed the man whom Speke had beheld as a boy—and who was described by him through about two hundred pages of his book as a vain, peevish, headstrong youth and a murderous despot, sedate and composed in manner, intelligent in his questions and remarks beyond anything I expected to meet in Africa. That I should see him so well dressed, the centre of a court equally well dressed and intelligent, that he should have obtained supremacy over a great region into which moneyed strangers and soldiers from Cairo and Zanzibar flocked for the sake of its supreme head, that his subjects should speak of him with respect, and his guests, so far as I could gather, honour him, were minor causes, which I venture to consider were sufficient to win my favourable judgment."

In other writings we find allusions to "His Majesty" and the "Earls," and phraseology generally which seems to us, in our superior and more comfortable knowledge, incongruous when applied to such a barbaric power. It certainly requires an effort of thought to hark back to the circumstances and conditions which produced the attitude of mind marking the writings of our early explorers in their references to Uganda. We must remember the vicissitudes they encountered in accomplishing their discoveries, the absence of pomp or any of the paraphernalia of government authority, and the great weight of the impressions which men travelling under such disabilities must have felt in emerging from the meaner conditions of countries of disintegrated control upon the comparatively splendid isolated organisation of Uganda. We have only to read Sir Samuel Baker's accounts of how he was made to feel the power of even such a lesser potentate as Kaba Rega to grasp in some degree a sense of the expressions which pervaded the writings of those days. After all, the impressions of which I speak were acquired by Englishmen, whose names were surely a guarantee for a sensible statement of visible facts, and so we should interpret their expressions. If there is any feeling of incongruity of expression, as viewed from present-day standpoints, instead of being critical of them let us rather reflect how is it that with all our advanced facilities for civilising work we have not carried on the native power with a worthiness for the same characterisation since the introduction of foreign influences. For my own part I see no need to be despondent, for it is not long since that power was exercised in much of its old time strength, when hundreds of European lives depended much upon the effectiveness of that power, a historical and significant fact which at times escapes the memory in our anxiety to reform native countries out of all recognition of their natural selves. This has, perhaps, been somewhat of a digression, but it fills part of my purpose in emphasising the fact that it has been a not altogether ignoble base upon which the stages of progress have been built.

But the display of barbaric power had the usual concomitants of unbridled gratification of the passions and caprice. Even hundreds of lives were immolated on the impulse of a moment, on a known occasion merely, as the King said, "to bring these people to a fitting sense of due subjection to authority." Nevertheless, bad as conditions were, and sad as is the picture which has been drawn of those terrible times, a trace of justice could usually be discerned in general procedure which had hitherto been greatly deficient in the reign of Mtesa's predecessor, and was altogether lacking in that of his successor.

A few words will bring history up to the date of the introduction of British authority. Mtesa had died after having done his best to elevate the country and himself to greatness. He had much changed the character of the circumstances of state; throne, gold embroidery, parades of firearms, and evidences of extended foreign trade were witness to his disposition to move out of the purely native groove. Moreover, his receptiveness of modern ideas had improved his character, and he left his country dominant in those regions. His place had been given to Mwanga, a man in whose nature power developed the most despicable meannesses, and in his hands began the country's decline. Colonel Lugard has likened the young king to Rehoboam, and remarked that, "whereas in the days of Mtesa there had usually been some show of accusation and condemnation, or at least of cause, for any arbitrary seizure and execution, there was now absolutely no security for life." Disputes and conflicts arose among aspirants for the throne with alternate repulses and successes. The good which might have emanated from an introduction of missionary influence at the earnest appeal of Stanley, was greatly modified by the creation of religious sectarian rivalries, and we have a long story of Protestant, Catholic, and Mohammedan conflicts which supplemented the King's incapacity in practically destroying the whole conditions of material prosperity in Uganda. But there were marvellous developments in the character of the people which seemed to be passing through a cleansing fire. Colonel Lugard, in reference to that time, says:—"Christian converts were burnt after mutilation and torture in great numbers, but they showed extraordinary heroism, and in many cases openly declared their faith and refused to escape, while others came forward to be baptised in spite of the fate which awaited them." It may be said in fact that the period of adversity which the country passed through, and the sustaining example and teaching of the missionaries evolved a much broadened and generally improved disposition, especially among the chiefs, and so by influence among many of the people; and this should be taken

as a sterling compensating advantage to be weighed against the depressing misfortunes which had fallen upon Uganda. But I doubt if it is too much to say that in this period between Mtesa's death and 1902, the country by strife, destitution, and emigration, lost a quarter of its population.

British Authority Introduced.

It was during the period of political chaos that Sir Frederick (then Captain Lugard) appeared upon the scene, and under the flag of the Imperial British East African Company laid the foundation of order with such splendid courage and ability, and with such sympathetic magnetism, that his name will ever be identified with the era of inauguration of civilised order and progress in Uganda. His name is a talisman wherever he has been, and I could wish to have, or to give to those countries, no greater satisfaction than in telling them I have again met him and received for them messages of kind remembrance.

Unyoro.

It has been impossible to refrain from giving almost exclusive attention to Uganda in these pages, so far did the attractions and interests of that country transcend those of any of its neighbours. Unyoro alone could claim some rivalling interest in the power it gained from its united subjection to one ruler. Is it not a historical truth that among African races such a ruling force is essential for their government, and that once that force which holds the masses together is wrecked and the people thrown upon their own resources for government, the decline of that race begins?

Notwithstanding this advantage, Unyoro itself had also, though in a somewhat different way to that of Uganda, undergone a partial decay. It yet included, as of old, the country known as Toro—since become a separate kingdom—and a large block of territory to the south, which lately was diverted to Uganda in warfare. It also possessed an ascendancy influential over much of the Nile and Central Provinces, and over part of the country to the west of the Albert Lake. Nevertheless, Kabarega, the king, was a savage, nothing more, and instead of ruling with the aid of an organised cohesive government, he maintained his dominance by a process of playing tribes off one against the other, a procédure already beginning to pave the way for the disruption which followed his later reverses. Like the rulers of Uganda, he was merciless in the assertion of his power, though not perhaps to quite so bloodguilty an extent as the more civilised king of Uganda, and hundreds of human lives were sacrificed merely at the promptings of capricious whims.

Ankole, Usoga, &c.

Very few words will be sufficient for allusions to the remaining countries. Ankole was a separate kingdom, liable to raids from Uganda, to which power it had from time to time been brought under subjection. This is the home of the Bahima, or Ba-huma, a much overrated race so far as they have proved themselves in that country. Usoga was under subjection to Uganda, occasionally rebelling but always suffering defeat with terrible slaughter. With regard to the more northern territories, those about Mount Elgon and in the vicinity of Lake Rudolf, little was known, and the countries of the Nile Province were part of the Egyptian-Soudan, which had been sadly harried and impoverished by the Dervishes.

Introducing Present Progress.

This completes my description of the base upon which civilising forces have built their progress. It will be seen that a powerful native kingdom had in the hands of an incapable king been allowed by factional troubles to become altogether disorganised, and that the first steps had been taken for the restoration of order by means of British influence and authority. I will now endeavour to convey to you an impression of the success which has been attained by those means. I do not propose on this occasion to follow all the stages of the gradual progression which has marked the building up of the Protectorate, interesting though they were, but to launch at once into an account of present day conditions.

Accessibility.

In doing this, the subject which I find brought most prominently to general notice is that of the enhanced accessibility of the Protectorate. To appreciate completely the advantage so gained it is essential that you should have in mind the foretime circumstances of travel. After landing at Mombasa, on the East African sea coast, amid surroundings crudely Oriental, it would be possible, after a month or so of infinite patience, to organise a caravan composed chiefly of slaves, who would be allowed to engage by their Arab masters on condition

that they were to have half share in the pay to be earned. If fortunate in securing capable supervision the caravan might be taken on fairly intact; frequently the only material available as porters would be bad, and desertions would dislocate arrangements. When *en route* there would be constant anxieties—water failing at the end of a long march where it could reasonably have been expected to exist; water having to be dug for; delays encountered in getting food supplies; plans to be devised for the carriage of food through even twenty days' marching through uninhabited country; precautions to be taken against savage tribes, principally nomadic; ever to be wary against misleading guides, against epidemics, whether of disease or temper among the men; and so cares would multiply until in the course of two or three months according to exigences, Uganda would be reached by the weary caravan. Think of the change brought about by the construction of the Uganda Railway and the establishment of steamers on the great lake! You now land at Mombasa to find it is so far Europeanised that you can obtain every requisite comfort, from accommodation in the hotels to the smallest necessaries in the outfitters. Trains run twice a week to the lake, so you can take your ticket, and in a railway journey of 584 miles pass, in less than 48 hours, through country attractive at times in its varied scenery, at others in the beautiful wild animals of its plains; and at more or less proper intervals, creature comforts can be satisfied at station restaurants. Then at the lake you meet the weekly steamers, each of 600 tons, nicely fitted even to electric lighting, and so in 18 hours, with stoppages, cross to Uganda over 170 miles of water begemmed with beautiful islands; a delightful experience altogether in fine weather, though in other weather, fortunately not common, the lake is quite capable of lashing itself into a fury which compels the vessels of earlier days to run to shelter. So that whereas in 1890, and, indeed, for some years later, the journey from Mombasa to Uganda occupied from two to three months, and carriage of goods, restricted to 60 lbs. loads, cost from £200 to £300 per ton, it can now be done under four days, and goods according to their class are carried in any required bulk at rates ranging from £3 to £15 per ton. Such exceptional merchandise as wines or spirits command higher rates.

The great steamer lines from Europe have also undergone their progress of improvement, and it is now usual to leave London *viâ* transcontinental railway routes to Marseilles or Genoa, there to meet the steamers and proceed to Mombasa, arriving there from seventeen to nineteen days from date of departure. Thus it is possible to reach Entebbe in twenty-one days from London, as our mails have actually done, or, in any case, in not more than twenty-five days.

The cost of transit of common produce from Entebbe to London under present circumstances is little over £5 per ton, and is steadily reducing itself; in fact, it is simply a matter of quantity, or even genuine prospects of quantity, upon which reduction depends. Concessions have been granted upon carriage of produce requiring special nursing, as well as upon agricultural implements, a term read very liberally by all the railway authorities.

Then we have excellent telegraphic communication and an admirably organised mail service, so that for a country so remote the Protectorate may be said to have as advanced means of accessibility as can reasonably be expected under the circumstances.

Entebbe.

On landing at Entebbe at a substantial pier, there will be seen good serviceable brick buildings, official, commercial, and residential, all now having passed the thatched-roof stage and entered that of painted iron and tiles. These for the most part are surrounded by well-tended gardens, and are situated on well-kept roads made beautiful by avenues of shady trees. Government House, the High Court, Hospital, Post Office, and other such buildings, mark the official character of the town, while a growing number of offices and shops and a busy activity in that quarter mark the steady advance of trade. In the early morning large numbers of natives can be seen falling into groups for the day's work, or for caravans moving into the interior. From 3,000 to 5,000 congregate daily in Entebbe for a labouring wage of 5s. to 6s. per month, and for porterage of, say from 6s. to 10s. There are also the Botanical Gardens, which to great beauty add great utility in the practical character given to its experiments. In the distance ecclesiastical buildings, ringing church bells and signs of much movement in that direction, denote, notwithstanding that Entebbe is not a great native centre, that degree of success in mission work which in these countries far exceeds that usually won in Central Africa. Then one is greatly impressed with the moderate temperature and by

the healthy appearance of the Europeans of both sexes; even by that of the very young children who in recent years have indicated by their presence a confidence in the increasing salubrity of the climate.

MENGO AND KAMPALA.

The same air of improving prosperity is spreading throughout the whole country. In Mengo, the Uganda native capital, a lead is given to all towns of especial native distinctiveness. There are seen conspicuous on hills, the king's residential and official buildings and three cathedrals, that of the Anglican Church being a stupendous structure, a fine example of the capabilities of natives under a strong supervision. Within view in the near distance is the Government Station, Kampala, with its well laid out official and commercial quarters. Throughout and dotted about among beautiful banana groves, are the large brick dwellings of the chiefs, rivalling those of the Europeans; while in the vicinity of the cathedrals are, a splendid hospital, schools of various grades, including industrial, and the residences of the members of the several missions. From the general centre diverge good roads to all parts of the Protectorate, and it is a cheering sight to view the continuous streams of natives passing along those roads, all bent upon peaceful avocations and with never a weapon among them. The stranger would be struck with the remarkable quiet of the Sunday, so strictly observed here—the streets and roads being quite empty during the hours of service, which thousands attend attired in their best.

GENERAL TOPOGRAPHY.

There is some variety in the general topography of the Protectorate, and much in the climate of its constituent parts. The main level of the country in the vicinity of the Lake Victoria is about 4,000 feet. After passing a narrow edge on the border of the lake undulating ground of luxuriant vegetation is met with. Then travelling over 50 or 60 miles of this there is another strip of comparatively bare country of 30 miles or so, leading on to yet higher country, generally of exceeding fertility. Travelling north after passing the Victoria Nile and away from the Nile banks, there are alternate fine pastoral and agricultural expanses with occasional lapses into sterile patches of more or less extent. The whole is well watered, in Uganda by slow running streams so checked by vegetable growth that huge swamps have formed: in other countries alternately by such swamps and by more or less beautiful rivers or streams.

AGRICULTURE.

Throughout many of these countries are seen huge and luxuriant banana plantations, an indisputable criterion of the richness of the soil, and in other localities are fine grain crops. Vast natural forests of useful timbers spread over portions of the country, sheltering valuable rubber vines, one forest, at least, including myriads of rubber trees. There are several others of which little is known. Then in the advanced spheres there are coffee and cotton of an almost indigenous character rapidly being supplanted by an extensive cultivation of better imported varieties. Trials of cultivation of imported coffee produce crops approaching one ton per acre per year, and the Mocha, Jamaica, Guatemala and Liberian varieties all thrive.

The field for cotton production seems to be unlimited, and although the industry on commercial lines is altogether new to the country, will reach several thousands of tons in the following year. So far all is produced by natives. Tests in Para rubber culture are quite successful, a fact of vital importance, as they promise to provide a substitute for great losses, caused by destruction in native collection, of indigenous rubber vines. The tests applied to many hundreds of trees prove a growth of seventeen feet in two and a-half years, and a general average growth of six feet per year. There has also been discovered a new rubber plant of great value, as well as the existence in great quantities of the *Funtumia elastica* trees of West Africa. Uganda prepared rubber has reached as high a price as 6s. per lb., and it is proposed to sustain, if practicable, the highest standard of its quality.

Sansivera and other fibres help to swell the exports, a recent discovery promising a variety valued at from £35 to £40 per ton. Indigenous chillies have had a great market for a time. Rice and lemon grass have proved successful. Tests in logwood, Brazil nuts, pimento, and cinnamon have made fully satisfactory progress. Imported cedar trees have grown to 40 feet, with a girth of 40 inches in six years, and that under imperfect conditions; there exists also an indigenous variety in satisfactory growth. English flowers, notably roses, and vegetables flourish well; in some instances improved, in others deteriorated by their change of home, but in the aggregate they

give gratifying results. The staple vegetable and fruit is the banana or plantain, of which there are a multitude of varieties. Pineapple, guava, mango, custard apple, Jack-fruit, limes, lemons and oranges have all fruited well in Entebbe.

In preparing a recent paper I was surprised to learn on expert opinion that botanically speaking no country was known to be so free from insect pests!

The Botanical Department, which has been so active in this branch of progress, has brought its statistical results up to date, and will be in a position to add greatly to the valuable information already supplied by it. The work of this department is one of extreme interest—the conditions which it encounters contain so many factors of an entirely new character. Uganda is situated precisely on the equator, yet has a climate ideally temperate, and a good rainfall (60 inches). Consequently there is a fascinating degree of uncertainty about experimental work, and a kind of medley is often the result, the produce of tropical and temperate climes frequently flourishing side by side, together with instances of peculiar modifications where distinctive characteristics have definitely adapted themselves to their surroundings.

In my belief in the future of this wonderfully fertile country I am anxious to see yet further exploitations of its resources by the development of a special agricultural department, established upon Board of Trade lines; one whose sole purpose will be to use, amplify and publish our knowledge in a manner suitable for purely economic purposes; for so far as is yet known it is agriculture that will be the backbone of commercial progress in these countries.

Minerals.

Indications have been discovered of the possible existence of minerals; indeed, to quote one instance, an eminent scientist has declared that the geological stratification of Unyoro, as judged by rock specimens, is practically a duplication of that in the Rand. But all mineral discoveries so far produce only conjectural results, and until these can be tested by geological surveys, succeeded by some practical prospecting, it is impossible to give any decided opinion as to the mineral resources. A great deal of the geological knowledge has so far been acquired in travel at the rate of about 15 miles a day and so, I assume, can scarcely be judged as conclusive.

Communications.

I suppose there is no country in the East of Africa better, if so well, intersected with roads of a passable character; certainly, considering its newness, there has been remarkable local activity in this particular direction, one which appeals strongly to me, so convinced am I that one of the greatest factors in the exploitation of any country is an effective opening up and maintenance of good communications. Throughout half of the Protectorate there must be 600 miles of roads, some practicable for wheeled traffic, all broad and well kept, and so safe and comfortable for ordinary foot traffic. Formerly the narrow winding paths which distinguish African lines of interior communications afforded opportunities for assaults from man and beast, and in the earlier days it was difficult to induce mail runners to travel at night, even as it is at the present day in remote districts. Now in Uganda and in the greater parts of Unyoro, Toro, and Usoga, it is most unusual to see a man with weapons of any kind, though naturally there is still need for solitary travellers to be cautious in the night; elephants, lions, and leopards being then active outside populous parts; the elephants more than ever so, the other beasts fortunately becoming scarce.

The increase of profitable trade is advancing at so substantial a rate that consideration is being given to the need for extending the railway to these countries, and practical tests have been applied to certain lengthy waterways with such success that the expediency of adding them to the scheme of communications is contemplated. Even when traffic is impeded by waterfalls, as in the case of the Ripon and Murchison Falls, compensatory advantages offer themselves in facilities for the conservation of force of considerable value. So pressing is the demand for an easy transport of the inland produce, that there is even a revival of old-time proposals for the clearing of the sudd from the channels of some of the swamps where there is sufficient depth of water.

Economic Progress.

A striking instance of progress is seen in the desperate efforts of the steamer authorities to keep pace with the growing volume of trade, efforts plainly manifest in the much-varying movements of the small fleet, accompanied by constantly-expressed longing for the doubling of that fleet. In reality these wishes are now in course of being gratified. You find that the

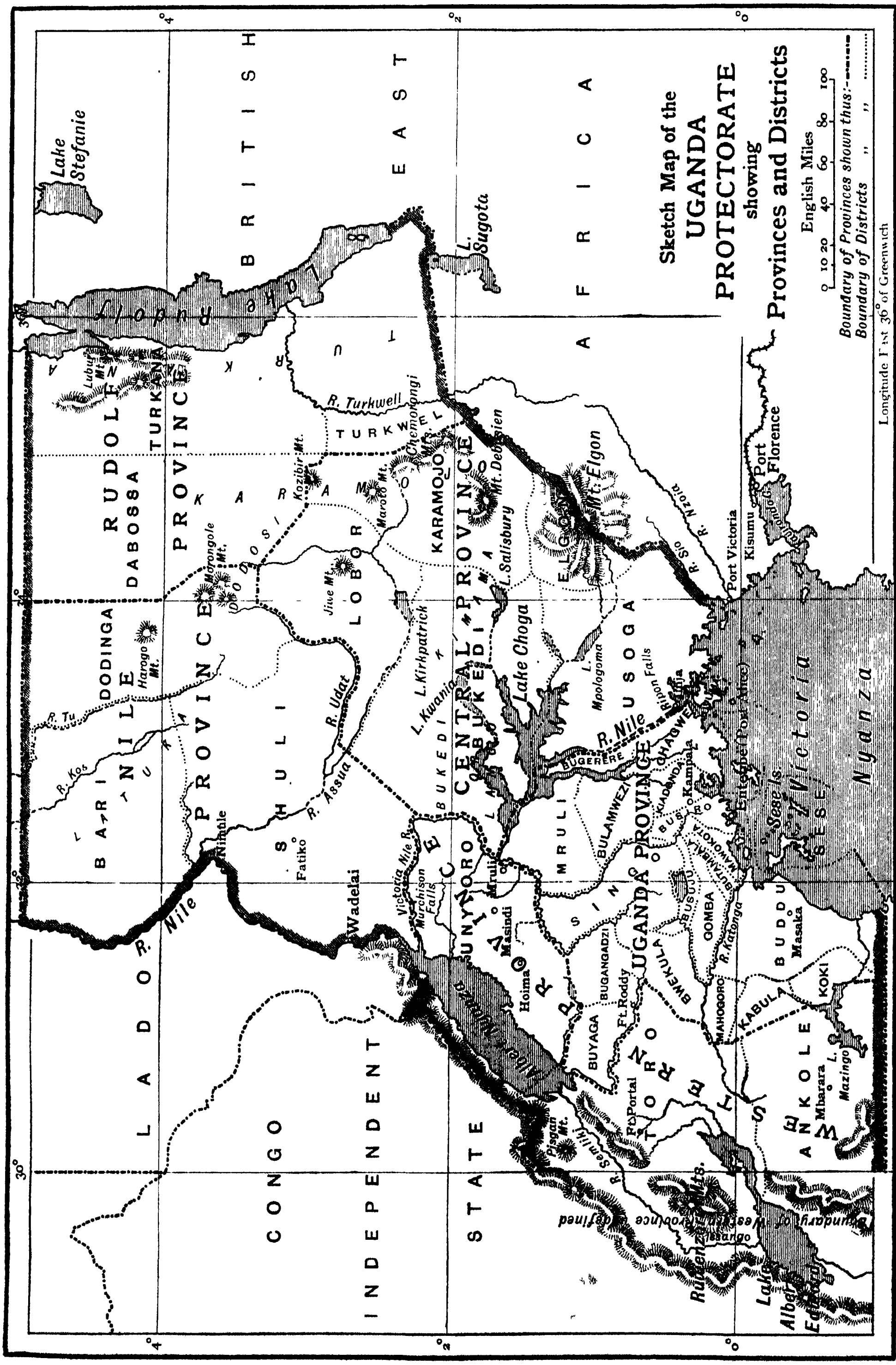
supremacy of Entebbe, the capital, as a port is rivalled by that of Kampala, and then, actually that of both by Jinja, which is in the vicinity of the outflow of the lake into the Nile, and is the official town of perhaps once the most belated country in the Protectorate. These facts may not mean much to the general listener, but to those intimate with local affairs it means three distinct strides in commercial and industrial development. What is it that causes all this? We find, on looking round, wagon loads of cotton, fibre, coffee, grain, hides and (so far in smaller quantities) rubber, native-made butter and coarse sugar, all making their way to the several wharves. We find these again are supplemented by natives carrying their loads to the stores to be later repacked for shipment; in fact, the produce exported from Uganda along the Uganda Railway during the last financial year reached a value of £107,000, a result already exceeded in the nine months of this financial year. The imports progress at the same rate, and it is cheering to reflect that the trade of the Protectorate must at the present day represent a sum of over £300,000 sterling. A further source of satisfaction is gained from the fact that revenue in the last financial year increased from £59,000 to £75,000, and that without including import customs to the extent of from £10,000 to £15,000, which, owing to the inland situation of the Protectorate, is collected at the seaport, Mombasa. Especial attention should be given to the further disadvantage which is temporarily suffered by these revenue figures. To foster agriculture, common products have been removed from the schedule of export duties, and to facilitate business in general other taxes have been reduced or abolished, particularly those upon the registration of porters, which in the days of difficult communication was necessary for the protection of natives engaging upon caravan work. Though the comparison of an actual gross revenue of about £90,000 against an expenditure of double that amount may not seem to offer much scope for gratulation, it is still encouraging to know that the era of progress is so far forward in a country where there was nothing to start from apart from what could be gained from trade in ivory, a trade now almost defunct. We can well assume that as since the completion of the railway, revenue figures are making real leaps by many thousands of pounds per year, very few years will elapse before the Protectorate can become at least self-supporting, enjoying at the same time all the gratification to be derived from a progress made, in respect to native interests, in studied conformity with humanity's best laws. This onward movement is not restricted as of old to Uganda alone—Usoga is forward, almost on a level with its leader—Unyoro and Toro are coming on with substantial help, and Ankole following a little behind. The Nile Province alone is backward of those under administration, which tardiness to a great extent must be attributed to its secluded situation.

Nothing whatever has been done in respect to the opening up of the Rudolf Province, so it lies for the moment somewhat outside the scope of this paper.

I admit to some feeling of disappointment with the small share British commercial enterprise has had in the development of trade in this Protectorate. Some month or two ago I read in *The Times* an announcement by a distinguished German, reflecting upon German colonial activity as compared with that of the British. To illustrate his view he instanced the Uganda Railway. Much as I would like to soothe my patriotic inclinations by accepting this statement without further question, I deem it wiser to face the truth, hoping to spur on effort by adding that last year's exports from German Lake ports to the Uganda Railway were almost equal to those from Uganda, notwithstanding the fact that we enjoy a great handicap in the more favourable agricultural resources of our territory. This is unpalatable, not because of the increasing volume of German trade, which we welcome, but in its significance of wasted opportunities. It is, therefore, great news to learn that British enterprise is at last moving to this field, and that large business undertakings are in progress to make use of opportunities offering no small promise of profitable return. This news will be agreeable to well-wishers of the natives, who are responding quite reasonably to calls upon their industry, and who, in Uganda alone, profited last year in earnings from a single company to the extent of £10,000.

Climatic and Health Conditions.

In dealing with countries of this character, it is fair that we should do so in full consideration both of their useful qualities and their disabilities. In the former category we have in the main parts of the Protectorate a perfectly genial climate, one which is ideal in its temperateness, its only fault being a lack of invigorating changes to cold. Except in abnormal circumstances, such as those in


Sketch Map of the
UGANDA
PROTECTORATE
showing
Provinces and Districts
English Miles
0 10 20 40 60 80 100
Boundary of Provinces shown thus:
Boundary of Districts " "
Longitude East 36° of Greenwich
Emery Walker sc.
BRITISH EAST AFRICA
CONGO INDEPENDENT STATE
LADO
RUDOLF PROVINCE
NILE PROVINCE
CENTRAL PROVINCE
UGANDA PROVINCE
Lake Rudolf
Lake Stefanie
Victoria Nyanza
Albert Nyanza
Lake Choga
Mt. Elgon
R. Nile

the Nile Valley on the one hand, and the highest altitudes on the other, the mean maximum throughout the year is 77, the minimum 65. Is it not difficult to believe that in regions situated precisely on the equator the mean maximum temperature is from 10° to 16° below the records of the hot days of our own last summer in England? But then unfortunately there is no winter, and in the course of years the uniformity of temperature produces an enervation upon Europeans requiring at least a temporary change of climate to aid recuperation. It is this which makes one reflect as to the suitability of the country as a field for complete schemes of European settlement. There is no doubt as to the greater part of it being adequate for the purposes of planters—those who can afford to utilise and superintend native labour; but so far there is little encouragement for the hope that it will do for white manual labour. Speaking from the point of purely personal feelings, I am not greatly concerned at this outlook. The available native labour promises to be rich in skill and quantity, and among a people who are characteristically sensitive to class distinctions and prejudices and allow their fine discriminations to freely influence their conduct, I could foresee endless complications arising out of the presence of a white labouring class in the country.

But great work has been done in improving the hygienic conditions of the large centres. It is difficult to keep pace with the wishes of the able experts, even those who guide the administrations in their health-saving work in anti-malarial sanitation and such vital measures, so impatient are they in their great knowledge of the vast strides in that work accomplished by modern schools of tropical medicine. Yet remembering the numberless calls made upon governing bodies by departments, each loyally believing itself to be the hub of existence, it is sensible surely to expect that some degree of caution should be exercised before venturing upon large schemes put forward in full enthusiasm, promising though those schemes may be. I do not think there is reason to greatly complain of the advance made by the health department in such a sphere as that under actual administration in Uganda. Where our officers were liable to frequent and repeated prostration from disease, where one saw more or less pale and sickly spectres borne up by the glamour of pioneering which alone sustained them, now, notwithstanding existing climatic disabilities, your attention will be more readily attracted to sports clubs frequented by hale and hearty-looking men, consequently able in their improved health to do their legitimate work well, and in all ways to experience a real joy in living. Mosquito-proof rooms and anti-malarial municipal schemes generally recommended by the experts in tropical diseases have been introduced with remarkable success, and it is difficult to say to what degree of perfection those countries, whose very air once seemed poisoned, will one day be brought by a proper use of the rapid and marvellous discoveries of modern medical science.

I am anxious not to be dogmatic in my description of our Nilotic countries, as my experience in the rainy season was so favourable as to be contradictory of most reports of recent years, and so I concluded that it was necessary for me to repeat the tour under the less promising conditions of the dry season, before arriving at definite conclusions. As it was, temperate climate and beautiful green scenery, with an absence of mosquitoes, prevailed, once away from the Nile valley. My wife accompanied me even into the hinterland of these remote countries, and we both enjoyed perfect health throughout an extended tour. She has travelled with me over most of the Protectorate during the last seven years, and leaves with me again on Friday; so this statement may, perhaps, be taken as evidence of the sincerity of my, or rather our, conclusion that existence can be made at least tolerable in those parts of Africa. In fact, as a general indication of the health conditions, I should say that several ladies have proved by experience that the climate can be endured, and as that has been done on occasions under almost heroic deprivation of essentials of every day comfort (which is now avoidable, I am glad to say), it may reasonably be hoped that with a continuance of the present policy of co-ordinating principles of living there with those customary at home, there will be such an improvement in general health as to one day lift the country out of the category of unhealthy climes.

Of course, the natives are reaping their share of these great benefits, for fortunately the masses are outliving their old-time superstitious prejudices against our medicines and sanitary methods. To quote an example, I have myself been frequently a witness to the prevention of expected epidemical disaster by the wholesale resort of the natives

to vaccination. In such medical care of the natives the Church Missionary Society, with its very perfect equipment, does noble work, one which is nowhere more readily acknowledged than in the Government medical department.

Much is being done to educate the people in the prevention of other diseases, and in particular, and much to my relief, there is hope that the terrible rate of infantile mortality can be reduced by the abolition of habits opposed to all modern recognised health requirements.

Any readers of Ashe's booklet on "Life in Uganda" must have been struck with his account of the repulsiveness of the unsanitary habits of a people reputedly so greatly ahead of their immediate neighbours in neatness and cleanliness, and it must have been obvious that those qualities were merely superficial. This is now much changed, and with fitting supervision on our part quite a creditable advance in sanitation has been promoted in all the larger centres; to such an extent, indeed, have the principles been understood and appreciated that I have even considered the expediency of introducing in such a centre as Mengo a municipal system in which the native chiefs should be given, under guidance, a great share of responsibility. We have, however, to remember that with all this advance it has been found somewhat difficult to secure a full measure of co-operation from the chiefs and people in combating that dreadful scourge, sleeping sickness. I cannot well explain why it is so. With an epidemic such as small-pox there are instant symptoms and a speedy crisis, something more dramatic to appeal to the feelings, and so to incite instant activity in its eradication. In the more slow and mysterious disease, there is as yet little of a definite nature to grapple with, and the native is no believer in putting forth energy for a purely problematical return. The advanced chiefs are chary of hazarding their presence in affected areas, but the unsophisticated peasant, native-like, acts as if he were immune from a danger which does not present itself in a tangible form. There is no doubt whatsoever that when a cure is definitely proved the people will flock to avail themselves of it; even the reports of a promising experimental character are already attracting numbers.

I regret that I have little news of moment on this subject to add to that already public. It is known that the Protectorate has lost over 150,000 of its inhabitants by this disease. Various medical commissions have grappled with it, each with more or less degree of success in arriving at cause and effect, but in disappointment as to prevention and cure. Within the last few weeks our hopes were buoyed up by a rumour pointing to the discovery of a cure, but, as Major Ross indicated in *The Times*, there can be no solid foundation for any such report; for years, two at least I am told, are required for conclusive proofs. The truly satisfactory advance lies in the large expansion of the field of scientific research within recent times. The work of eradicating the fly by clearance of foliage shading water in the vicinity of largely inhabited centres, much frequented ferries and water supplies and such like measures is proceeding, but it is cumbersome, and is only practicable in limited areas.

Truly every one must join in an earnest hope that no matter who is to win the glory, a remedy and a preventative will soon be proved to be effective to stop the loss of thousands of lives which, natives though they be, are valuable units in the composition of a colony.

NATIVE AFFAIRS.

On this particular occasion I have devoted less space than is usual in direct allusion to purely economic details. This is due to two causes. One is the conviction that in the present and its succeeding years there will be a substantial introduction of commercial enterprise, which will require corresponding advance in matters of an administrative and general political character to secure a smooth and satisfactory course for the march of that enterprise. The other lies in the great interest which is at the moment being centred round native affairs, and it has been mentioned to me that views on that large question would be welcomed in quarters where the subject is given serious attention. It must be borne in mind, too, that a true and lasting economic prosperity in such tropical African countries as Uganda is completely dependable upon conditions secured only by a wise government of the natives. Let me mention labour as one of the most important instances. We in Uganda have some pride in the prosperous contentment of our natives, even though I have heard it said that the rate of economic progress there is not up to the possible standard, and is not, for example, up to that of the colonies further south. It is not for me to dispute that opinion, or to plead the advantages won in the South by the colossal influence of such a man as Rhodes, of the immense capital of such

an institution as its Chartered Company, and, as much as anything, perhaps, of the vicinity of the vast mining industries. I feel that it is something to be able to assert most emphatically that, if economic progress has been dilatory—a supposition open to contention—there has been no delay in the enlightening progress of our native races, and you may be sure that when economic prosperity does reach its highest standard, it will, if affairs follow their present course, have done so side by side with that of our natives and with their full co-operation.

It is upon this principle of consideration for the well-being of our native peoples that the governing policy is based. All the civilising forces of the Church and State recognise the wisdom of this procedure, and cordially harmonise their operations with that policy, and so with a kindly but firm insistence upon simple principles of probity in native conduct, and an almost extravagant observance of every requirement of honour and good faith in negotiations on our part, we are subduing the objectionable traits of their indigenous barbarism, and winning a strong confidence in the honesty of our purpose. In this the Missionary Societies loyally and cordially co-operate with the Government, and they have in those countries done a magnificent, and let us hope and believe, as we may, an ever-enduring work in the educational and moral upbringing of the natives; one which has been conspicuously serviceable in the sustaining of order through the very severe crises of recent years. The mutual advantages of this co-operation must be too obvious to be affected by such utterances as one occasionally sees in public print, calculated to create a rivalry for credit in the work of civilisation among those who have the privilege of sharing in it. It is well recognised that in Uganda, completely satisfactory results will be better secured by cultivating a spirit of inter-dependence; that this is so, can be observed in the admirable cordiality which marks the relations between officials and missionaries of the present day.

It is now my intention to devote serious attention here to the study of native affairs. I propose also to show that every effort is made to accommodate the accomplishment of our aims to the best trend of native thought and sentiment, and to avoid introducing reforms in a manner likely to needlessly offend native sensibilities. I have already stated that within the Protectorate, besides other divisions, there are four kingdoms—Uganda, Unyoro, Toro, and Ankole. Each of these countries is ruled by a king, aided by native councils, and is subject to a benevolent supervision by His Majesty's Commissioner or Governor, who is on ordinary occasions represented by the principal local administering or political officer.

In Uganda the present King, Daudi Chwa, is a son of Mwanga, and the fortieth of the line; a fact capable of proof in the existence of as many tombs, all having their history. He is only eleven years of age, and his powers are vested in a regency composed of the three leading chiefs. His education is the care of the Government. In Unyoro, Kaba Rega has been succeeded by one of his sons, Andrea, the fourteenth representative of a more modern dynasty. Kasagama, the King of Toro, is of a quite recent offshoot of the Unyoro line. Kahaya, the King of Ankole, represents a regime of about the same age as that of Unyoro. (In this case I am not so certain about my data.) All the reigning houses are believed to be of the same race (Bahima), and certainly are not of the aboriginal race. The Ankole local government has not yet reached the advanced stage of the others, and is at present in some disgrace, its functions being for the moment in partial suspension.

As Uganda is the pattern upon which the smaller kingdoms have voluntarily built their organisations since the inauguration of British control, I will describe, as briefly as may be expedient, the system upon which that country is now governed.

In the native capital there is an Audience Chamber, in which the King receives the petitions of his people, issues proclamations, and makes any announcements of a general national character. In this Chamber liberty of discussion is permitted at great length; a continuance of old custom, of course, improved, in procedure with the advance of education. Yet great caution is observed to preserve it from being advanced out of access by the humblest peasantry.

The King, himself, is directly advised in affairs of State by a native council, which is analogous in its duties to a parliament, but differing in its composition; membership being by appointment of the Council, and principally of chiefs of rank, supplemented to a moderate extent by private individuals of exceptional ability. This Council discusses all affairs of a national character, and includes within its range of duties decisions on matters of grave judicial weight, which are passed on from the native courts by appeal, or

by the native Chief Justice. It is this Council which the Government expects the King to always consult on affairs of local importance, and records are kept of the proceedings of all Council meetings.

There is next an institution called the Baraza, an Audience Chamber at which the King sits in joint presidency with the leading local political official. Here are heard and unravelled affairs which have puzzled the other Chambers, and petitions from natives believing themselves possessed of grievances against those other Chambers. There are also delivered announcements from the Government, carefully explained in all their detail. Opportunity is here given for the administering officer to educate the people in principles of local government, agriculture and general industry, and to get into and maintain intimate touch with the natives and their affairs. The influence which an able and tactful officer can exercise upon a country through this institution is enormous, and I hold that it is more by its establishment, and the confidence won by the open and frank discussion of affairs which it has encouraged, than by any other means, that the people have been brought into such contentment with our rule. It has ever been noted, that wherever the Baraza has been inaugurated, a fresh spirit of vigour has entered into the country, the natives feeling that through this institution they can share in the responsibility of government, even though it may be simply in the fact of their being able to keep conversant with affairs. In these Barazas, only the chiefs take part in discussion, and the order maintained is perfect. It is not difficult to imbue groups of these people with a fitting sense of propriety on such occasions; they always respond to judiciously-applied firmness. I wish it to be plainly understood that in the Baraza the wise political officer is seldom an obtrusive exerter of his authority. If he has well used his opportunities the chiefs will have become even too ready to lean upon him for guidance.

The same order, with only slight modifications, runs through the local governing bodies of the other kingdoms, and is being in principle applied to both the Central and Nile Provinces. In the kingdoms of the more advanced divisions, chieftainships are classified and registered, and their functions given definition. Records of all cases passing through the native courts are required so that proper supervision can be exercised over native judicial procedure. Some time must elapse before all this can be done in the more distant countries. However, there is a steady expansion of this organisation, from the centre, and where that occurs economic prosperity surely follows.

It is by means of such a system that great measures are smoothly put into operation. It is easy before framing legislation to gauge the beat of the native pulse, and to avoid such conditions as might unnecessarily offend native sensitiveness, or, as seldom happens, at least to impose them, if really essential, in the most palatable form.

The imposition of a moderate hut tax, for instance, has been managed with such mutual goodwill that the chiefs themselves advocated a like tax on bachelors, finding that a tax on huts alone led to unsanitary over-crowding, and bid fair to prove to some extent a check to marriage.

A great reform has been effected in the main principles ruling possession of land. Under the old rule practically all lands were the property of the State, which meant the King. Theoretically, the native Council had a voice in the settlement of land disputes which were nterminable, so complicated were the laws governing this question: in fact, about the only redeeming point in King Mwanga's reputation was his being the most able exponent of land laws in the kingdom, a reputation of ability difficult to reconcile with the imbecility of his follies. In practice, tenure was most uncertain, and a great impetus has been given to the agricultural industry by the conversion of fief tenure into freehold, there being created by this measure a strong community with settled permanent interests in the country.

Survey is being pushed on so that the delimitations of holdings may be defined and permit, with fitting precautions, of the diversion of unoccupied lands to genuine planters. The need of this is fully recognised, and measures are in progress for still further hastening the work.

In order that there should be full avoidance of complications in the tenure of the land, and to admit of harmonious adjustment of European and native titles to lands, a Commission has been at work for the better part of a year thoroughly investigating the conditions of native land tenure throughout the Protectorate, and it is proposed that upon the researches of this Commission, future land legislation shall be largely based.

Such complex laws as those affecting mar-

riage and succession have been, and are being dealt with. It will readily be understood that in a country hitherto under the governance of barbarism, the status of woman has required some amendment, and a better regulation of the state of marriage has had to be secured. But even these are simple as compared with the work of adjustment of property rights, and some time must elapse ere that question arrives at a completely satisfactory stage. It is, of course, difficult to suddenly adapt, with perfect results, advanced European laws so abstruse and far-reaching as those of succession to a country hitherto ruled by a comparatively simple totem system. Our legal advisers are fully alive to this, and advance is made with due caution.

To witness the able and intelligent discussion by chiefs, of questions such as these, and there are many such, is an enlightenment, and it is the improved state of mind brought to bear upon these discussions that marks one of the stages of the real progress of our influence. In this, and in a steadily rising grade of humanitarianism imparted into their judicial functions, we see a growing soundness of character of the utmost value in such a country's career. It is this intelligent and whole-hearted spirit which has marked the wonderful advance of Christianity in these countries, and it is with the fullest admiration that one sees the leading classes exert a substantial and practical interest in the immense native Church organisations, which, in the case of the Anglican Mission, are wholly self-supporting. Associated with these organisations, but in more complete control by the missions, are schools of various grades securing to succeeding generations highly educated chiefs and teachers and industrially educated classes to take their share in the material development of their country. Mission hospitals, great and small, alleviate the sufferings of thousands, and in several ways of like nature can the native feel the sincere sympathy and interest extended by the white race in its efforts to lift them on to a higher plane.

Some response to these efforts is apparent in the native character. Work has lost its native traditional indignity, agriculture is scarcely any longer a shame to manhood. Artizans are proud of their new sense of usefulness, while they know how to charge for it. I have mentioned that cotton and other plantations are spreading over the country initiated at our instigation, now expanding on simple commercial lines, that one sees loads of local produce approaching the chief centres. An appreciation of the better comfort attainable by industrial prosperity is seen in the increasing number of commodious brick dwellings in native precincts, and in the clean calico clothing which is so entirely ousting the filth-conserving bark cloth. House appointments are as yet rather primitive, but it is something to see the cleanliness and promising attempts at taste evinced by the better classes. It is also particularly interesting to note the march of education in the order entering into the keeping of records in chiefs' offices by young native clerks, using their typewriters with some proficiency. Their systems employed in compiling statistics may yet be crude, but they are not unpractical. Chiefs have begun to understand and utilise, to a moderate extent, the advantages of banking, and they are interested in industrial and commercial enterprises, in respect to which, after some lessons, they have acquired a wise habit of caution. The chief centre of all this new spirit is, of course, Mengo, the capital of Uganda, but it is spreading to Unyoro and Toro, is entering Usoga and Ankole, and with it all, the next five years should see a fine development in these countries of their commercial resources.

While the people are becoming more industrious of their own free will, I believe they are also more sober; in any case, there are no visible signs of that increase in real vice which is supposed to usually run concurrently with the advance of civilisation. I confess to being somewhat of a pessimist in respect to native sincerity, though optimistic perhaps as to ultimate possibilities in the development of native character, but after a fairly extended experience in East Africa, I can vouch for a reliability in the temperament of the natives of Uganda, Unyoro and Toro, which is as yet foreign to almost every other East African race. Whatever doubt may arise in the minds of sceptics as to how far action is guided by purity of motive acquired for education, or by simple self interest, the fact remains that the results are far above present rivalry from any neighbouring tribes. The most useful effects from this improvement in character are obvious in an appreciation of public interests and a steady abandoment of the habit of intrigue—the latter so rampant only five years ago, that it was impossible for a time in a country like Unyoro to obtain a collective expression of opinion on national affairs from among the chiefs—as is practically the case in the ex-

treme outer parts of the West and Central Provinces and in most of the Nile Province at the present day, all these being districts not yet brought within the effective reach of our complete control.

With an habitual tendency to believe in the efficacy of the policy of using the native chiefs to rule their country, and a consequent confidence in the principle of improving the character of the chiefs so that a corresponding improvement may be reflected upon the whole country, I have devoted most of my utterances to conditions principally affecting that class; and I wish it to be clearly understood that I maintain that so long as we refrain from being unduly meddlesome in the domestic affairs of the country, so long will the people be willingly amenable to the authority of the chiefs acting under our auspices, and to their improving influence as their education progresses.

I have presented a picture of a brightness the existence of which is indisputable. Yet with those who are intimate with the undercurrent of native thought, and are mindful of native history, the conviction remains that even amid all this glamour, it is still wise to maintain a policy of constant prudence, making sure that the reins of responsible control shall not in one whit be slackened.

We know that only a few years since these races were utterly at the mercy of the whims of capricious chiefs, to whom life was of no value. Hundreds of human beings would be slaughtered or many mutilated in a momentary fit of kingly vexation. Chiefs would slit a nose, cut off lips, lop off a limb merely for the accidental spilling of beer or the appearance of a hair in their food. It is the people accustomed to such treatment whom we have suddenly emancipated. It may be said, and said with some truth about many, that surely there must be gratitude for the relief from the dreadful oppression of the serfdom which characterised former days, and for the blessings of peace and prosperity which have now entered into the country. But let us look at the circumstances from all points of view. These people are emotional, they are conceited almost beyond belief. They have a dread of monotony, even a prosperous one, that is so lacking in any common-sense as to be inconceivable by the majority of our race. Stanley, who acquired such a friendly feeling for the chiefs as to have maintained a correspondence with the leaders for over 20 years, and spoke only four years ago in this hall in sympathetic interest with the people generally, described them, taken as a whole, as being crafty, fraudulent, thievish, deceitful, lying knaves; predatory, with a more developed instinct of lawlessness than any other African tribe. He goes on to say, that according to their opportunities they are heady, despotic, vain, sycophantish, from the great chiefs down to the peasant with a child to carry his gun. Truly, the writer must have been angry when he adopted this phraseology, even though he tempers it by allowing that they are neat, clean, and modest. Yet I have myself had moments, in more recent days, when I sympathised with his command of language!

Years later Colonel Lugard, whose friendly interest is indisputable, characterises them as indolent, affectionate, at times humane, with a tolerance towards lying and thieving; cruel, treacherous, and impulsive, one moment brave in their conceit, the next liable to reasonless panic.

"At one moment the countryside looks the home of endless peace; unarmed men and women are engaged in agriculture, or chattering over their wares in the market. Five minutes later some wild rumour has passed through the people like an electric shock, and, without heed to its truth or falsity, the war drums are sounding, and every hill and dale bristles with spears and riflemen. The friends of a moment ago are ready to take each other's lives."

These expressions have been used with especial reference to Uganda, but the same, with various modifications, can be well applied to the other countries. Now, splendid as have been the instances among them of moral and intellectual development, we cannot believe that these people have in such a very short time of peace and prosperity utterly and permanently changed the very base of their national character. Truly, the serfs of yesterday have generated, under our fostering care, a sense of liberty, and a corresponding attitude of independence, but they have also developed a jealous sensitiveness, and are prone on the slightest provocation, and when they think it safe, to indulge in objectionable insolence. They being conceited, is it to be expected that their progress has made them other than even more bumptious?

All raw natives, almost without exception, have their moments of aberration, of succumbing to unreasoning moods, moments which they themselves often deplore, and it is those moments that every administration should be prepared for, confident in the case of the more enlightened districts that once tided over

the very culprits themselves will be the most grateful for having been protected against themselves. This is the crux of the question. We are the superior race by virtue of our ability to teach and to restrain, and the natives readily acknowledge this, as they readily throw themselves upon us for the responsibility of judgments in decisions in all grave crises, and will continue to do so until generations of civilisation remedy their mental defects, or we gratuitously or out of mistaken sentiment throw them entirely upon themselves. Natives under a wise restraint can be like good and even clever children. Natives in their wild impulses and with passions aflame can be very devils incarnate.

Within my experience, on more than one occasion, even a Regent has stood up in the Council and, in reply to my regret at having to reprove the chiefs, has said boldly that when the restraining hand is withheld from them then will Uganda decline, "for," he would add, "we are but as children, well-meaning mostly, but at times woefully wilful." Public expressions of this sort are not to be ignored, for Uganda chiefs have their pride and much of it, and do not readily waive their dignity in such admissions.

On this native question I know what I am talking about. Our Chairman himself will, I am sure, bear me out, that many have been the crises in which a knowledge of native character, and the need to control it, has enabled me to save the situation. I break my rule of personal reticence in this manner because I feel the subject is a serious one, and know that there is a kind but yet mischievous public sentiment growing in favour of the extension to natives of a liberty of self-control for which they are not yet ripe, and which would only be the cause of their undoing. Let us go on educating them gradually up to a sense of their responsibilities, guiding them in their work of governing their countries, sustaining them when their energies flag, as they often do, commending them when they do well as they yet more often do, but ever firmly retaining an ascendancy. If we lose that ascendancy, we might then leave them to their own natural devices, capable of buying, selling, slaying, or robbing each other; even, at their worst, of slashing open the bodies of captive women, impaling children on spears, everything that is horrible and evil, and all of which they have done less than ten years ago in the very countries we are now dealing with, and as they are still quite possibly doing when passions get loose in the countries outside the limits of our influence, and will so do until we extend a hand to bring them under our care. I think that you will agree with me it is wise that we should go on with our work on our own lines—a work already so fruitful of the blessings of peace and order. And in this connection I am able to say that excepting in the case of a dispersal of a predatory band of mutineers only one punitive expedition has taken active measures since 1899, a period of eight years; and in that instance it was to demand retribution for wanton murder by an outlying tribe.

There is a large class rising from among the people seemingly entering upon an entirely new phase of life, one showing every indication of a moral understanding made extraordinary by its surroundings and by the country's own past. With judiciously expended sympathy and support this class will still expand and bring the country on to a higher plane of usefulness.

Conclusion.

I have cause to be proud of the honour to-day gained by Uganda, the subject of my paper, in the presence of so distinguished an assembly of gentlemen directly concerned in the evolution of that section of the African Empire. Its history is incomplete without the name of Sir George Mackenzie, who pioneered in person the inauguration of the great scheme so long before conceived by Sir William Mackinnon. We have Sir Frederick Lugard, so appropriately our chairman to-day, as the founder of British authority in Uganda. With these there is Sir Clement Hill, who, as Superintendent of the African Department, so long represented the mainspring of government, and then Colonel Hayes-Sadler, who so recently relinquished the Uganda Commissionership with the satisfaction of leaving the country on the safe road to economic prosperity. I glance further towards Bishop Tucker, for fifteen years the chief representative of Church Missions in their historic African work, and a cordial friend of every Uganda administration. Truly such a gathering is a distinction.

I have at times used bald language to press home in your minds comparative pictures of the barbarous past and the bright and promising present, and I earnestly hope that I have succeeded in convincing you that under a governing policy of a benevolent control, in sympathetic alliance in countries which have

nationally adopted Christianity with that of a tolerant and Christianising training and education, there is no mean tale of progress to unfold.

DISCUSSION.

The CHAIRMAN said he was sure the audience would accord a very hearty vote of thanks to Mr. Wilson for his interesting and suggestive paper, and he thanked him personally for the very kind way in which he had referred to himself. Contrasting the picture of Uganda, as drawn by the author, with what it was when he (the Chairman) knew it, the progress shown to have been achieved was a proof of the ability of our race to meet what he thought to be the great question of the twentieth century—the development of the tropics, with a view both to the good of the natives inhabiting those countries, and also to the increasing wants of European nations as far as raw materials for manufactures were concerned. The first part of the paper had been devoted to the early history of Uganda, to the days when Speke first discovered it in 1860, or thereabouts, and it might, perhaps, be interesting if, for a moment, he recalled some of the conditions under which Uganda came to be British. It was sixteen and a-half years ago since he received orders to proceed to Uganda, and make a treaty with its king and people, and endeavour to bring it under British control. It was not an easy task, for Dr. Carl Peters had already preceded him with a view to annexing it to Germany, while Emin Pasha was coming from the south-east, and was understood to have similar instructions. However, he (Sir Frederick Lugard) reached Uganda, and succeeded in making the treaty, but he could not forget Christmas night of 1890, when passions ran very high, and it seemed to be touch and go whether their little force would be attacked and exterminated, or whether they should succeed in their object. However, with the help of what was called the British, a party which was at that time much the smaller of the two hostile factions into which the country was divided, they succeeded in obtaining the treaty, and for the next year they devoted themselves to trying to solve the main difficulties between the two parties, and to bring peace into the country. During that year they succeeded in bringing the third, or Mohammedan party, into the country, who had been, as it were, outlaws on the frontier; and they also brought down a body of Soudanese soldiers who had been left by Emin Pasha in his equatorial province, and who, being without a leader or master, were doing terrible damage by raiding the whole of the country in which they temporarily found themselves after their exodus from the Sudan. Those men were brought back to Uganda, and they formed to this day the nucleus of the troops with which the country had been held. Towards the end of 1890 it seemed as though some real kind of progress had been made, and that the two hostile factions were beginning to settle down in peace, when suddenly a spark set the whole ablaze, and before they knew where they were the two factions had flown at each other's throats, and their little party, together with the English faction, had to defend themselves against attack. It seemed at first as though all their hopes and all their efforts of a year had resulted in complete failure. But looking back by the light of after events it was, he thought, perhaps, the best thing that could have happened for the country, because such a warlike and excitable race as the Waganda would never have settled down in peace until it was decided which was the stronger of the two parties. Again they set themselves to the task of endeavouring to promote peace and settlement in the country; and as they were progressing, as they thought, from a state of turmoil and war, a still heavier blow fell, for he received a letter from the Directors of the Chartered Company, whose agent he was, to say that its funds would no longer permit of their retaining Uganda, and that he must make what dispositions he could, and evacuate the country. It was a hard blow, and he hardly knew what to do. But he did not carry out his orders, and stayed on. He had the thorough sympathy of the Directors of the Chartered Company. It was not their fault that funds did not permit of his remaining, and the British Government would not give it the assistance required in order that the Company should retain their position. Sorrowfully, therefore, in June, 1892, he turned his back upon Uganda and came home to England, to start a fresh campaign of a different kind,—to fight for the retention of the country. Most of those present had, no doubt, forgotten what a sharp campaign that was; the debates night after night in the House of Commons, and Mr. Gladstone's fiery eloquence. It seemed at that time as though it were a losing cause; but Lord Rosebery, the Foreign Minister, stood forward as the champion of Uganda, while England and Scotland spoke out unmistakeably in favour of redeeming the pledges which had been made to the people and those who had fought on our behalf, and retaining under the British flag the country which had become British, and not allowing it to be absorbed by Germany. Thus the campaign was won, and Uganda was retained. In the second part of his paper Mr. Wilson had dwelt upon the accessibility of the country, and had alluded to railway extension. The retention of Uganda was synonymous with the construction of the railway to get to it. In fact it was practically impossible to retain the country without such a railway, because the cost of transport was so enormous. When they tried to place before this country the reasons why Uganda should be retained, they pointed out its extreme importance, at the sources of the Nile, to Egypt and the Sudan; they showed that if that country fell into the hands of another power the control of the waters upon which the vitality of Egypt depended would pass beyond our control; and they spoke, also, of

the extraordinary possibilities of the country, its productiveness, and the salubrity of its climate. He himself was considered an enthusiast; but his words were nothing like as strong as those he had heard since from men who had gone and settled in the country. He had been told by some of these that the climate of East Africa was unrivalled on the face of the earth; but of couse, the area in which that fine climate obtained was a small one. Nairobi, the head-quarters in East Africa, could now boast of a large population, whilst there were many hotels and other buildings. Only yesterday he received a copy of the newspaper published there, in which one column was devoted to the local advertisements of shops, whilst another column was filled with the list of distinguished visitors staying in one single hotel. Altogether the progress and the conditions of life at Nairobi appeared to be better than were ever even anticipated in the old days. A deputation recently waited upon the Prime Minister with regard to African railways, and he had said, in reply, that in the Uganda Railway we had an object-lesson of how not to do it. But apparently the overwhelming calls of his high office had prevented the Prime Minister from studying the latest statistics of the Uganda Railway, and he must have been rather alluding to the general belief of a year or two ago, when there was a prevalent pessimistic view that they had made a great mess of the Uganda Railway. But what were the facts regarding that railway to-day? It had, as was known, been completed but a few years. And though, perhaps, the initial capital expenditure on the construction of the line was greater than it need have been, the fact remained that to-day the railway was not only paying the whole of the working expenses, but was already returning a dividend upon that large capital. The dividend, though at present a small one, was yearly increasing. There was, he thought, every prospect of the Uganda Railway turning out a really valuable national investment of capital. But an undertaking like that must not be dealt with on its mere merits as an investment. Germany and France had found it worth their while to subsidise their colonies to the extent of several millions a year, without expecting any interest on their capital, because there were in those countries raw products in the shape of cotton, fibre, and rubber, which were so valuable to their industries. England, also, was paying annually certain grants in aid of some of its Protectorates, not very large in amount compared with Germany or France perhaps, but on these grants we were not looking for any return at all in actual dividends. There was in the Uganda Railway an investment which bid fair to prove a really good one, while, in addition, it was giving assistance to British trade and industry in the ways which had been described by Mr. Wilson in his paper. He had received that morning a letter from Sir Charles Eliot, who until quite recently was Commissioner in East Africa, regretting his inability to attend the meeting, and quoting some figures he received only a day or two ago from East Africa, which showed that within the last two years the imports had doubled, and that the exports had more than doubled, while the receipts of the Uganda Railway had increased from £124,000 to £222,000, which was very nearly double. He thought these statistics were very pertinent to the subject of the paper, because, although the railway did not actnally enter Uganda, it was the main artery upon which the whole life and vitality of that country depended, and which alone afforded it a chance of expansion. Mr. Wilson had told them, and it could be also seen from the Blue-books concerning Uganda, that the Protectorate had doubled its imports and exports within a period of three years. The author had also referred to the railway freights, and told them that from Uganda to the coast, and *vice versa*, they varied from £3 to £15 a ton, and that the cost for special articles was very much more than that. Calculating the distance as 720 miles, though it was really over 800, that worked out at from one penny to fivepence per ton mile. Those rates seemed to him very high, and with all due deference to experts, he thought that if they were somewhat reduced, it was very probable that there would be greater progress and equally large returns for the line. We had heard that such enormous quantities of produce were pouring in for transport, that the steamers on the lake could not cope with them, and large accumulations were taking place. If, therefore, the reduction of freight rates by the railway should result in a traffic greater than it could compete with, it would be a very strong argument in favour of doubling the line, which many were now urging should be done. He thought it was the duty of the person to whom was accorded the honour of presiding at a meeting, such as this, to crystallise into such a form as might remain in our memory a few of the facts which the wealth of the expert knowledge of the author placed before us, and to draw from them a few useful conclusions. With regard to the Uganda Railway, from the facts before them, he thought he could say, without fear of contradiction, that a policy of well-considered extension was quite justified—a policy of gradual extension onwards towards the Albert Lake, to tap the shore of that inland sea, and a policy of constructing small feeder lines which might bring additional cargo to the main line, and develop new areas. It had been a great pleasure to him to hear what extraordinary progress had been made in Uganda. No doubt there were some present who would remember that in the controversy which arose at the time of the controversy as to the retention of Uganda, Mr. Labouchere made great sport of an accidental phrase which he (the Chairman) made use of when he said that the people of Uganda were so progressive that they wanted rat-traps and white donkeys, and ridiculed the economic progress of people who wished for such things. To-day the people were wanting type-writers and account books! Mr. Wilson, he was glad to say, had given just praise to the

mission agencies, which had done an enormous work in Uganda, and, looking at the matter from an administrative point of view, had relieved the Government of the great problem of education. Mr. Wilson had also eulogised the research work done in Uganda in connection with sleeping sickness and the study of malaria. No praise could be too great for the devoted men who had risked their lives in the areas which were subject to sleeping sickness, and he hoped that their efforts would soon be crowned by some practical results. In the meantime, however, he thought that there were certain lines upon which the Administration itself might do as good work as scientific experts. Speaking from long experience, he believed the greatest mortality in Africa was caused by infantile enteritis, due to the insanitary condition of the native towns, and the contamination of the water supply. It was quite within the power of the Government to tactfully bring pressure to bear by which those conditions might be improved, and the lives of an enormous number of young children saved. Another great drain upon the population was the small-pox scourge. That, again, was under administrative control, for, if the medical officers vaccinated the people of their districts, the disease would be stamped out. He would conclude his observations with one or two remarks upon the latter part of the paper, for it was that portion which, to his mind, was the most interesting, as it gave them a glimpse of the machinery by which all this progress had been achieved. They were told that the affairs of the country were discussed in a native council, presided over by the king; membership of it was apparently by co-optation; and it was apparently invested with judicial power as an appeal court, from the native courts and the "native chief justice." Perhaps Mr. Wilson, in his reply, would tell them something about the native courts, and of whom they consisted, what powers were entrusted to them, and whether they included the power of passing a sentence of death. It would also be interesting to know whether the decisions given by the native council were subject to any sort of review by the British administration. He should like to know, too, of whom the Baraza, which was under the joint presidency of the king and the local Administration, consisted, and how they were elected. Was it a national assembly, like the old Saxon Witenagenmot, at which every free man could attend, or was it constituted by any form of election? He should like, also, to have further information as to the hut tax and the bachelors' tax, for it was not quite clear to him why the hut tax had proved to some extent a check to marriage. The brief remarks of the author about the conversion of fief tenure to individual tenure were, of course, of great interest, for it had always seemed to him that the real emancipation of the natives consisted in the recognition of individual ownership, which meant individual responsibility. It was no use liberating people wholesale from serfdom or slavery unless their individual responsibilities to the State were simultaneously recognised.

Sir Clement L. Hill, K.C.B., K.C.M.G., M.P., said he wished that somebody else had been called upon to speak at that moment, because, besides the eminent administrators he saw in the audience, who had already been mentioned, there were present men who had worked in Uganda, and who had contributed very largely to the control of the country and to the development of its resources, such, for instance, as Colonel Coles, who commanded the troops, and Mr. Whyte, who laid out the Botanical Gardens. He could only suppose that he had been called upon to speak because he had been so long connected with the Foreign Office, and he was proud to think that he had been associated with the affairs of East Africa since the days of Sir Bartle Frere. He went out in 1872 with Sir Bartle Frere to put an end to what was then almost the only East African subject that interested England—the slave trade and slavery. He was glad to think that it was left to him to mention that subject, for it had not been referred to either in the paper or the Chairman's remarks. The fact that slavery and the slave trade had not been referred to was, he thought, a very great mark of the success of the past work of the Government. The slave trade and slavery were a thing of the past, for England had succeeded in putting it down. He believed that the Chairman, Mr. Wilson, and the Governor of East Africa (Colonel Hayes Sadler) would corroborate him when he said that slavery had practically died out in East Africa. That they owed to those great pioneers of civilisation who had risked their lives and given the best of their days to the work. Sir Frederick Lugard had risen to his present position by no armchair work, but at the risk of his life. The Chairman had not told them why it was he was sent to Uganda; and very few present, perhaps, remembered that it was because when he came up as a junior captain of the Norfolk Regiment from South Africa on leave, he found that in Nyasa the people were in great extremities, were being oppressed by slave traders, with no military man to help them. It was then that Captain Lugard joined them. He was twice wounded, and took part in the attack upon Mlozi's forts. He saved the situation there; and it was largely owing to his work as a soldier, and not at all as an Administrator, that we now held British Central Africa. Mr. Wilson, too, owing to his great modesty, had omitted to say that it was very greatly due to him that the English held Kampala when Major (now Sir Charles) Macdonald, suppressed the mutiny of the Soudanese troops. Mr. Wilson had assisted in keeping Uganda quiet, and was rewarded, he was glad to say, with the C.B. which he now wore. There was one lesson he hoped those present would carry away with them: the need for great patience when considering the actions of Administrators in the wilds of unknown countries.

It was easy to criticise them and to write letters to *The Times* and other distinguished newspapers, and to raise an outcry against them and ruin their career simply because somebody might say that this, that or the other man had committed an indiscretion at a moment when nobody knew what the circumstances or the surroundings were or how difficult the position in which he might be placed. Others would impress upon them lessons of commerce, lessons of geography, and lessons upon other things; but as having been connected with the administration of those countries for nearly 40 years, he would ask them to bear in mind the fact that they ought always to give credit to the man on the spot for knowing what he was about, for having some reason for his actions, and for at all events being imbued with the best intentions and best wishes for the honour and glory of England and of Great Britain. He would conclude with the words of the motto of the Colonial order, "*Auspicium melioris ævi*," we had seen in Africa the dawning of a brighter day.

Bishop TUCKER said he might be forgiven if, as representing the Anglican Church of Uganda, he confined his remarks simply to the work of the Church there. In 1890, when Sir F. Lugard entered the country as representative of the British East Africa Company, there were but some 200 baptised Christians in Uganda; to-day there were over 60,000. Then there was but one place of worship, a tumble-down shed, which was dignified by the name of a church. To-day there were 1,700 places of worship scattered throughout the Protectorate, ranging from the little country church which would accommodate possibly 20 or 30 worshippers, to the great Cathedral church of Namirembe, which would hold a congregation of some four or five thousand. All those churches and the school-houses were built, maintained, and repaired entirely from native sources. When Sir F. Lugard and he first met in Uganda there were, he supposed, some five or six natives engaged in the work of teaching their fellow-countrymen. To-day there were nearly three thousand men and women engaged in carrying on the work of the Church, of which thirty-two were native clergy, maintained also from native sources. Then, there were some seventy communicants; now, there was a noble band of some sixteen or seventeen thousand. Then, there was for the purposes of education but a little handful of children; now, there were in the elementary schools some 24,000 under regular instruction. With all his heart he believed that the people of Uganda had a right to share in the administrative, industrial, and commercial life of their own country; the Church was, therefore, throwing all its strength into educational work, so that the people might be thoroughly well fitted to play their proper part in that life. Besides the elementary schools there was at present a very remarkable educational experiment being made, which was nothing more nor less than a high school which had been formed at Mengo, intended mainly for the sons of chiefs. It had been found that amongst the most neglected lads of the land were the sons of the chiefs, their fathers being most unwilling that they should associate with the sons of the peasantry. A high school, therefore, had been formed for them, and at the present moment there were 130 sons of chiefs, or young lads who were themselves chiefs, but minors; the idea being that they should remain entirely in English hands for something like three years, being thoroughly taught and trained on the public school system and under house masters. From there, they were passed into a higher intermediate school, which was founded upon the hill of Budo, hard by Mengo, and there they stayed for another three years. What the effect on the future of Uganda was likely to be when those 200 young chiefs, as they hoped the number would soon be, went into the country to take up their government, and carried into their administrative life and their chieftainships, that which they had learned in those schools could well be imagined. That, he thought, was one of the most interesting developments of the educational work at present in hand, and he looked forward with hope to the foundation in the not distant future of some collegiate establishment, some university, to which the intermediate school would serve as a source of supply. He believed that they had before them in Uganda a future bright with hope, and that they would find that from Uganda there would radiate north, south, east and west, an influence which would tell on the well-being and uprearing of nations in the surrounding countries.

Mr. SIDNEY GOLDMAN said his acquaintance with Uganda was very slight, and extended only to a trip which he had recently made, and from which he had only just returned. During his trip opportunity had been afforded him of forming certain distinct impressions as to the possibilities of the country, which he might describe as being in the zone of the Congo, and as the heart of British Africa, not only in a geographical sense, but also, in time to come, from an economic standpoint. Mr. Wilson had told them that the administration was devoted to spadework, in other words, to the process of civilisation, and had admitted that under the benign influence of Church and State a great impression had been produced upon the native mind. He hoped the Church and State would further co-operate in the direction of bringing about a consciousness in the mind of the native of his value as a worker, because in that, he thought, lay the solution of the economic problem of Uganda. He did not believe, nor did he think anyone who had been in the country would contradict him, that Uganda was a white man's country, or was ever likely to be. It was, indeed, essentially a black man's country. He did, however, believe that there was great scope for the white man in certain directions, namely, in

taking places of instruction and laying out plantations, and more particularly in trade and commercial matters generally. In that direction he thought white man's labour would be extremely useful. Mr. Wilson had complained of the lack of commercial development in the country, but he did not see how that development could take place until the land question had, once and for all, been settled. It had been the policy of the late Commissioner, Colonel Hayes Sadler, and it was the policy of the present Commissioner, to push that forward, and limit the boundaries of chiefs and kings as quickly as possible. Until it was known what residue of the land was available, he did not see that much commercial enterprise could be expected. Mr. Wilson had drawn attention to the value of the opening up of trade by regular trade routes and the making of roads. If the Colonial Office would only take courage and assume a more forward policy, such as had been adopted by the railway in British East Africa, and extend the line from the Lake northwards, not only from a strategical but from a commercial point of view, great advantages would accrue. He had been studying the German papers lately, and they were quite envious that the trade from Nyanza should be taken by a British railway, and they were clamouring for a railway of their own. The sooner a railway was constructed to the Lakes and the trade for Uganda so secured, the better. Feeder lines would then follow the natural course of the Nile. He had quite recently listened in that hall to a very interesting paper on "The Cape to Cairo Railway," and he would specially like to call the attention of those present to a likely line of communication between Alexandria and Mombasa, *viâ* Uganda. As a glance at the map would show, the country was admirably adapted for it, for it was intersected by the arteries and veins of a perfect water system, with falls which could be utilised for the generation of electric power. Sir Clement Hill had referred to the great work which had been done by the staff out there, and if Mr. Wilson, when he returned to East Africa, would carry the sense of the meeting that that work was deeply appreciated, he was sure it would be a great encouragement and incentive to them in the future.

Mr. WILSON, in reply to the Chairman's remarks in reference to the Courts, observed that the Uganda Courts were controlled by the Uganda Agreement, whilst in other parts of the Protectorate the Courts were controlled by native court ordinances. Under these the chiefs could inflict penalties up to five years. All the sentences were open to revision, and, as he had mentioned in his paper, the records of all cases were sent to head-quarters. With regard to the Baraza, its members were the leading chiefs, county chiefs as they were called. With respect to the labour question, referred to by Mr. Goldman, he had mentioned in his paper that in one town alone a congregation of from 3,000 to 5,000 labourers might be seen ready for work every morning. The land question was a troublesome and vital one, and was difficult to appreciate. But quite recently a special commissioner had been sent out to superintend all the survey questions throughout the protectorate. In conclusion, he begged to thank the audience for the very cordial greeting which he had received.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Wilson, and the meeting terminated.

EIGHTH ORDINARY MEETING.

Wednesday, January 30th, 1907; SIR WILLIAM BOUSFIELD, M.A., LL.D., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Fazl, Shaikh Abdul, M.A., LL.D., Jullundher City, Punjab, India.

Green, George Arthur, Public Works Department, Poona, India.

Hartshorne, William Davis, Methuen, Massachussetts, U.S.A.

Henton, Samson Baskcomb, Boys' High School, Rondebosch, Cape Colony, South Africa.

Hough, Warwick M., 902, Rialto-building, St. Louis, Missouri, U.S.A.

Litten, John George, F.S.A.A., 241, Pitt-street, Sydney, New South Wales, Australia.

Naftel, Cecil Oakley, 20, Eastcheap, E.C.

The following candidates were balloted for and duly elected members of the Society:—

Amsberg, Simeon Ernest, Penang, Straits Settlements.

Bose, Asok, University, Birmingham.

Braithwaite, James E., 6, South-parade, Leeds.

Burt, Andrew, M.I.M.E., M.Am.I.M.E., Fleetshouse, Tranent, N.B.

Buyzer, Charles Allan Oswald, F.S.I., 128, Hultsdorp-street, Colombo, Ceylon.

Campbell, William Archibald, 144, Warren-avenue, Chicago, Illinois, U.S.A.

Chaussé, Alcide, 1051, St. Hubert-street, Montreal, Canada.

Dadachanji, Rustonshaw K., B.A., LL.B., Kalbadevie-road, Bombay, India.

Edwardes, Stephen M., Highfield, The Ridge, Malabar Hill, Bombay, India.

Emslie, B. Leslie, Dominion Agricultural Offices of the Potash Syndicate, 3, Holbrook Chambers; 104, Sparks-street, Ottawa, Ontario, Canada.

Hogg, John, 13, Paternoster-row, E.C.

Humphries, Albert Edward, Balfour-rd., Weybridge.

Johnston, John, B.A., The Villiers Endowed School, Limerick.

Kamm, Director, the Rigibahn, Goldau-by-Zurich, Switzerland.

Khan, Ahmad, Hosain, B.A., Sessions Court, Jhelum, India.
Law, J. A., Birkbeck Bank-chambers, Chancery-lane, W.C.
Middleton, Professor Thomas Hudson, M.A., Board of Agriculture and Fisheries, 4, Whitehall-place, S.W., and University, Cambridge.
Pennant, Claud Douglas, 2, Mitre-court-buildings, E.C.
Rowntree, Bernard, 20, Queen-square, W.C.
Schenck, F. E. E., Studio, 1A, West-street, Pimlico, S.W.
Seaton, Miss Ellen Jeannette, 93, St. George's-square, S.W.
Tatsuno, Professor Kingo, M.E., Imperial University, Tokyo, Japan.
Tyler, William Ferdinand, Royal Societies Club, St. James's-street, S.W.
Wilson, Fred., 24, Palace-gardens, Enfield, N.

The CHAIRMAN, in introducing the reader of the paper, said that Mr. Parsons had been brought to the consideration of the question of apprenticeship by finding how very many of the children who left the Board Schools went out into life and obtained work which taught them nothing, and which, a little later in life, landed them in an out-of-work condition. Mr. Parsons would approach the subject largely from the social side, which all who had been brought into contact with the County Council and elementary schools generally, or with the poor subsequently when they were out of work and needed assistance, knew was a serious and important one.

The paper read was—

APPRENTICESHIP.

By JAMES PARSONS, M.A.

It is proposed in this paper to give an account of the objects and work of an Apprenticeship and Skilled Employment Committee, and to add such comments as suggest themselves. The work is concerned with the industrial training of boys and girls who leave the public elementary schools. It has its root in a wide-spread conviction that the welfare alike of the individual and the community demands an increase in industrial efficiency, and that the means of improvement is to be found in the better training of the young. The education of boys and girls in preparation for their working life primarily concerns the parents, interested in the future of their children, and the managers of industry, interested in the efficiency of labour. These are the responsible persons. The matter nevertheless is one in which charitable persons who seek to improve the social condition of their poorer neighbours may play a useful part. The scheme is based on ideals which are clear and coherent.

Industrial training ought, it is thought, to be undertaken with definite regard to the prospects of the boys and girls when they have grown into men and women. Thus the selection of a trade by parents for their children should be guided by the promise which it affords that those who have learnt it will find in it regular employment, under suitable conditions, and at reasonable wages. It is, furthermore, of importance that the training of the children should be such as to turn them out artisans, instructed in their trade as a whole, as distinguished from those who know a portion of it only, and from "wasters" who know no part of it thoroughly.

The training, moreover, should be favourable to the habit of regular industry, and to a healthy growth in mind and body; while the conditions under which it is undertaken should be fair both to employer and employed. The fulfilment of these purposes demands an equipment of industrial information, not only with respect to the openings from time to time offered by employers to young people, but also on the past history, present condition, and future prospects of the several trades. Of such knowledge there cannot be too much.

An important feature of the scheme remains. It is sought to form a solid body of opinion on the propriety of securing a good start in life for young people, and to concentrate on this object the efforts of all those who in the home, the school, the office, the workshop, or the Council chamber, are in a position to aid in its accomplishment.

The experience of the writer has been gained in London as a member of the Whitechapel Committee of the Charity Organisation Society, which has carried on this work for the past 3½ years through a skilled employment sub-committee. This committee is one of a group of agencies which have sprung up in the last few years in order to carry out the objects which have been sketched.

It may be of interest to note the sequence of events out of which the work in Whitechapel grew. Efforts had been made for seven years previously to promote thrifty habits among the poorer inhabitants of the Whitechapel district. These efforts met with scanty success. The committee concluded that the low earning power of many of the inhabitants made it difficult for them to protect themselves against risks in the future at the expense of claims in the present. The committee turned to the promotion of skill in employment as a remedy for industrial inefficiency. The scheme, more-

over, promised to be remedial of specific evils, as will appear subsequently. It was sought in particular to strengthen boys and girls on leaving school, and their parents, to resist the pressing temptation which the conditions of trade in London offers, and to prefer hard work and low wages in a promising trade to high wages and an easy life in prospectless employments.

Advice was accordingly sought from those who had experience. The Jewish Board of Guardians had carried on the work of apprenticeship through their Industrial Committee for about forty years. Members of that committee gave timely help by generously placing their experience at the disposal of those who proposed to undertake the work. The procedure which will be described is a close adaptation from the practice of the Jewish Board of Guardians. Two other agencies should be mentioned. The East London Apprenticeship Fund had for seventeen years past carried on a similar work, assisting parents by loans to provide the necessary premiums. They had thus accumulated valuable experience. It was proposed as regards this and all other agencies to work as far as possible through those already on the ground. The Apprenticeship Committee of the Women's University Settlement in Southwark had also for seven years been engaged in apprenticing physically-defective children and the children of widows. A paper embodying this experience, prepared by Miss M. K. Bradby and Miss Durham, was read to the Council of the Charity Organisation Society in May, 1903.

The procedure adopted by the Whitechapel Committee will be now briefly described. Applications are entertained in respect of children whose homes are in the area covered by the Whitechapel Poor Law Guardians, or who attend a school within the area, other than Jewish children, who, as has been seen, are cared for by a committee of their own. The work at the commencement was treated as an addition to the duties of the Thrift Committee, a position which it soon outgrew. It got, therefore, the benefit of an existing arrangement under which the names and addresses of children leaving school are furnished by the masters and mistresses of the schools with a view to the payment of visits to the homes in order to persuade young people to join juvenile friendly societies.

The school authorities, managers, masters and mistresses, have proved themselves sympathetic and helpful towards the new scheme. They demonstrate in this as in other matters the genuine interest which they take in the welfare of the children. One gentleman, in a responsible position, on the scheme being explained to him, was good enough to style it the missing link between the age of dependence in childhood and the age of self-support in manhood. The helpful attitude of the London County Council will be mentioned later on.

Having got the names and addresses of the children, a visitor, as the next step, is sent to the home of each child. The visitor discusses future prospects with the child and the parents, urges the advantages of industrial training, and invites the parents to apply to the committee. If the suggestions of the visitor be not successful, the facts are reported to the committee, and the influence of those who have previous knowledge of the family—the clergy, district visitors, and other local agencies—is invoked. Such persuasions take time; the visitations for the purpose may last for weeks. The case of no suitable child is abandoned until it is made clear that the parents will not consent to any beneficial suggestion, or that it is hopeless owing to the attitude of the child, or for any other reason, to make further efforts. It is found, moreover, that the children in increasing numbers are referred to the committee with the consent of the parent, by the school master, club manager, clergyman, or other person interested in the family. Those who have been placed, moreover, not unfrequently send their younger brothers, sisters, and friends. It is pleasant to add that parents are generally found to display much solicitude for the future of their children, and are, for the most part, willing that while they are learning a trade they should receive lower wages than are current in prospectless employments. Some parents, indeed, are ignorant, or neglectful, or grasping, but the attitude of parents on the whole is hopeful for the future of the undertaking. Some of the parents who are the most anxious for the training of their children and the most willing to make the necessary sacrifices are themselves unskilled men who have tasted in their own experience the bitter fruit of neglect in youth. The difficulty is sometimes with the child even more than the parent. A boy's horizon is often limited. He may fancy something to do with horses or any other job pursued by elder companions, especially if it be not too laborious, be well paid, and be done in the open air.

The parent on making application is asked to supply information about the child and about the family—the child's name, address, age, date of birth and school; the names, ages and occupations of other members of the family, with details of employers and earnings; the number of rooms occupied and the rent paid. These particulars are accepted on the statement of the parent. They are not, under ordinary circumstances, verified by enquiry unless money help be deemed advisable as will be explained subsequently. It is desirable to get as complete a picture as possible of the child's home surroundings, as home conditions have a strong bearing on industrial possibilities and prospects. Information is next sought at the school. The schoolmaster is asked to report on the child's standard, state of health, character and ability, and to make any suggestion which occurs to him as to a suitable occupation. Should the child seem specially delicate in health the opinion of his doctor or of the committee's hon. medical adviser is obtained. Such opinions are valuable in order that an occupation may be selected which is, as far as possible, harmless to the child's health. If the child be already in employment the parent is asked to give the necessary particulars. The whole of the information is entered on a special form; to this form are attached any other papers relating to the child. The file of papers is numbered and constitutes the case-papers to which all subsequent reports, letters and other documents about the child are added. Each case is indexed in a card index under the surname of the child.

The next stage, the advice given to the parent, is the most difficult in the whole work. In making the recommendation diverse considerations are borne in mind; the character and family circumstances no less than the abilities, tastes, and wishes of the child; the credit of the committee with employers, a matter of great importance; the prospect that the parents, who often have views of their own on wages and other things, will consent; the likelihood of an opening being available in the employment selected with an employer whom the committee is prepared to recommend. It is important that the blow should be struck while the iron is hot. If there be delay the parent or child may come under other influences in the choice of an employment, or the family may taste the sweets of higher wages than are forthcoming in good employments, or the opening known to the committee may be no longer available. The hon. secretary, therefore, or other worker who deals with the parent takes the responsibility, under ordinary circumstances, of making a recommendation without waiting for a meeting of the committee and reports to the committee what has been arranged.

A word may be added on the constitution and functions of the committee. An ideal committee is representative of all persons interested in the welfare of the children: in the home, the school, the office, and the workshop. The adhesion of the parents is important. The promotion of industrial training, like other influences on social habit, will not have its proper effect as an addition to the national life until the working people themselves are convinced of its necessity, and bring the public opinion of their own class to enforce it. The functions of the committee include supervision over policy, procedure, and expenditure. At its meeting every part of the work is discussed, and projected alterations and extensions are authorised. As regards each child on the books, the committee receives a report on the employment arranged or contemplated, gives directions in circumstances of difficulty, and decides whether and upon what terms further efforts are to be made on behalf of the child.

In approving the selection of a trade, the committee does not restrict its choice to any definite group of occupations. "Changes in industry," writes Miss H. W. Jevons, hon. secretary of the committee, in her paper on "Industrial Prospects for Boys and Girls" in the September (1906) number of the *Charity Organisation Review*, "have altered old meanings, and a skilled workman is now no longer a handicraftsman; he may be a machine-tending artisan. After all, the terms are only relative, and a skilled trade may best be distinguished from an unskilled by its requiring greater resourcefulness, general knowledge, and intelligence, as well as some training in the use of special processes and materials, the longer the training required the more skilled the work."

It is thought, therefore, that any occupation may be suitable which requires some training, which offers a prospect of continuous employment, and which fulfils the other desirable conditions. Nor is it deemed indispensable that the child should be bound by indenture. The children are placed as seems best, either with or without indenture, suiting the arrangement partly to the character and home

influences of the child, and partly to the custom of the employer and of the trade. Among openings in which indentures are not used preference is given to the employers who treat their boys and girls as if they were under articles, and give them opportunities of learning the trade if they be so minded.

When the parent has given a preliminary consent to the selection of a trade and of a particular opening in it, the committee undertake the duty of conducting the triangular negotiations between the parents, the employer and themselves. When satisfactory terms and conditions are agreed upon the child is taken on probation for a period, usually one month, before the arrangement is concluded. Employers, it is gratifying to state, almost without exception, prove themselves sympathetic and often express their satisfaction at the arrangements made for bringing them in touch with promising boys and girls. It is important that this good impression should be retained and deepened. On all grounds the good-will of employers is indispensable. It is advisable, therefore, that discrimination be used in introducing the particular child to the particular employer; the committee, moreover, while standing firm for the plain interests of the children, should avoid any thing in word or in deed which may be construed as undue interference or partiality in trade disputes, or other contentious matters.

In negotiating with the employers care is taken to stipulate that the children, whether to be bound by articles or not, shall be permitted to attend such technical classes of instruction as may be suitable. The due development of the artisan demands an admixture of theoretic and practical instruction. It is found, moreover, that those who profit most by technical instruction are those who are learning the practice of the trade in the workshop.

When a child is placed a further step of great importance remains to be taken: the committee appoints one of their members or other friend as guardian of the child. The duties of the guardian appear from a paper of suggestions drawn up by the committee in the following terms:—

"As 'Guardian' to a child you will be expected during the apprenticeship or period of learning the trade,

"1. To become on friendly terms with the parents and child, so that they will at once inform you if any trouble arises in the workshop, and to report it to the committee.

"2. To visit the child every month in order to ascertain that all is right.

"3. To report to the committee formally twice a year on the progress made by the child in your opinion and that of the parents; such reports to be given at the first committee meetings in May and November of each year. [N.B.—The committee will obtain a report from the employers.]

"4. To urge the child to attend such evening, continuation, or technical classes as seem good to you or are recommended by the committee.

"5. To encourage a child to join a juvenile friendly society during apprenticeship.

"6. To discharge such duties as arise out of the indentures, when such indentures are signed by you.

"N.B.—After the period of learning is over, the committee will be obliged if you will, from time to time, inform them of the further progress of the child in order that the after career may be ascertained."

The aftercare of the child through the guardian is important in order to secure a prosperous issue in the interests of both employer and employed. It adds, moreover, the personal touch which is as the breath of life to this as to every other form of charitable effort.

When it is proposed to apprentice the child a form of indenture which has been approved by the committee is suggested to the employer. Two special features in it may be noticed; the guardian is made a party to the indenture and is given the power of cancelling it on failure by either master or apprentice to fulfil its conditions. The master, moreover, covenants to permit the apprentice to attend technical classes of instruction without loss of wages.

When the usage of the trade, or the opening chosen, or the crippled condition of the child is such as to make it necessary to provide a premium, the parent is referred to the East London Apprenticeship Fund, which provides premiums on loan to suitable parents, without interest, repayable over a period of years by small weekly instalments. The secretary of the fund also keeps a list of openings and undertakes the preparation and completion of indentures. Apprenticeship committees working in a district not covered by the East London Apprenticeship Fund make, it is believed, similar loans. When the parent of the apprentice is unable owing to widowhood or other sufficient cause to repay the premium in this manner, the family are referred to the Charity Organisation Committee, which investigates the circumstances in the manner usual in applications for charitable relief, and makes a recommendation according to the

result of the inquiry. In approved cases the amount required is raised by application to endowed and other charities, to City companies, and to private persons. Such cases are not numerous. The funds available for them are considerable, and the committee in making such recommendations are gratified to aid in fulfilling the intentions of the original donors of many of the endowments.

As regards the numbers dealt with the committee's reports show that in the three years 1904-5-6 there passed through the books the names of 136, 138, and 142 children respectively, of whom there were satisfactorily placed 25, 26, and 40, or 19, 19, and 28 per cent. respectively. Of these 91 children, 39, viz., 24 girls and 15 boys, were bound as apprentices. The remaining 52, viz., 28 girls and 24 boys, were placed as learners or improvers without indentures. Out of the 39 apprentices, a premium was paid in 11 instances only, viz., 8 boys and 3 girls. Of these 11 premiums, 7 were provided by way of loan and 4 by gift. These figures are important as showing the large proportion of the work which may be carried on without the payment of premiums. In considering these figures it should be remembered that those who pass through the books are not, with some exceptions, selected children, but consist of all sorts and conditions of boys and girls as they leave school.

The 24 girls who were placed as apprentices were employed in 8 different trades; the 15 boy apprentices in 10 different trades. The 28 girls who were placed without indenture were employed in 15 different trades; the 24 boys similarly placed were engaged in 13 different trades. (Lists of these trades are given in an Appendix). Taking together those who were and those who were not bound as indentured apprentices, 52 girls were placed in 19 employments, and 39 boys were placed in 21 employments. Taking boys and girls together, 91 children were placed in 40 different trades. It is relevant to note the number and variety of the different employments.

The committee has not been long enough at work to be able to give useful particulars of the actual result of the training on the young people. The boys placed by the committee are still in *statu pupillari*. Some of the girls have served short terms of apprenticeship. The reports on them are on the whole satisfactory, and indicate improvement in conduct, manners, and health.

The account which has been given brings into strong relief the need of acquiring a varied stock of industrial information. It is desired to give each and every child who leaves the school, the opportunity of entering the trade suitable to his capacity. The committee are interested in all the children, and do not, with slight exceptions, aim at securing preferential treatment for any child. An important part, therefore, of the committee's work is concerned with the accumulation of facts, and the investigation of the conditions of industry. Such enquiries are necessary in order to appraise the several crafts and occupations according to their suitability in the present, and their prospects in the future.

It is necessary, as a second point, to obtain detailed information about the openings, which are from time to time available in the several trades. Such information will include the wages paid, the hours of work, workshop regulations and practices, the position of the employers, their treatment of the employed, and other points. The committee's workers visit the employers in order to gather the necessary particulars, and they take the opportunity of getting as much information as possible about the trade.

All this knowledge has to be gained, like other social information, by gradual accumulation. It is, at present, in a rudimentary state. In no part of the work is effort more needed than in the Intelligence Department It is clear, indeed, that the sufficient acquisition of information, in both its branches, is beyond the power of a local committee immersed in administrative details. The undertaking, therefore, is one which lends itself to a division of function between the local committees and a central association. To the local committees seems suitable the work of getting into touch with the necessary persons, of persuading parents, negotiating with employers, and placing and watching over the children. To a central association seems suitable the receipt, co-ordination, and supplementation of industrial information obtained by local committees so that the whole body of information may be available to each and all of them. The utility of such a division of function was proved by the experience supplied by the Bureau for the Employment of Women, who for three years from 1902 acted as such a central body to which were affiliated local committees dealing with girls. It became clear that the benefit ought to be extended to boys. In 1905, accordingly, with the cordial concurrence of the Central Bureau,

the Apprenticeship and Skilled Employment Association was formed in order to undertake the duties proper to the central body. Local committees dealing with boys and girls may become affiliated to the Association and obtain access thereby to information and more numerous openings of employment. The affiliated committees at present number 10.

It is time to pass on to the comments which the account suggests. The training of young people in a trade has uses other than the augmentation of earnings. It may be regarded as a continuance of their education; a drawing out of their capacities of mind and body, an opportunity for the inculcation of thrift, as a discipline and a means of growth in the traits which befit men and women. This aspect of the work should ever be borne in mind. It would not accord with the objects of the committee that a child should be instructed in a single process only, however high may be the reward of his dexterity. It is hoped through the scheme to provide a partial antidote to the modern tendency to reduce workpeople to the mental condition of animated machines.

The scheme is remedial in another way. Modern society is based on the free exchange of commodities and services. Thousands of men and women fail to secure sufficient maintenance owing to the insufficiency of that which they offer in exchange. They get little because they give little. They are unable or unwilling to do, or to do regularly and continuously, that which is useful to other people. The committee desire to equip the rising generation with an improved capacity of doing that which has a sufficient, regular, and continuous value in exchange. The labour of those who become skilled in supplying their neighbours' wants will add, in the words of Adam Smith, to the "common stock where every man may purchase whatever part of the produce of other men's talents he has occasion for." There is abundant scope for such increase in production. The home of each producer is a market for the yield of all producers. In thousands of English homes the standard of living is low; narrow incomes leave desires unsatisfied. A rise in purchasing power in these homes will cause an expansion of the market. It is relevant in this connection to call to mind the variety of trades in which the children were placed even in this small undertaking. The acquisition of fresh markets for British industry is in these days an object of solicitude. In the interest of markets travellers explore, diplomatists negotiate, statesmen annex, engineers build, taxpayers groan, soldiers bleed. These efforts command sympathy and approval. It must not, however, be forgotten that all the while at home, at the very doors, lies a great potential market in the unsatisfied desires of thousands of men and women, whose productive capacity, now uninstructed, falls far short of their capacity when instructed. The work of the committee may in one aspect be deemed an effort to create such a new market.

An increase in the productive power of the people, furthermore, is likely to prove remedial of the evils arising from lack of employment, of which much has been heard in recent years. These evils are of long standing and have deep roots. They grow out of untrustworthiness of personal character, the cyclic alternations of activity and slackness in trade, and modern conditions of industry, including an increasing subdivision of employment, and the growth of cities. The evils in question, moreover, have been aggravated by the dominance of a public opinion as to the responsibility of the community towards the workers, based on a misinterpretation of both social facts and social duty. Public men and the dispensers of voluntary benevolence conspire to undermine the poor man's self-reliance, and forestall the efforts on behalf of his family to which affection prompts him. The distressful symptoms, indeed, connected with lack of employment, do not come as a surprise to those who have watched the social drift. Anxiety has been long felt with regard to the upbringing of children, especially in cities. The influence of the home has waned, and the strongest of all educative forces has thereby lost much of its power. Parents come before magistrates, and assert with grave faces that children of nine years of age are beyond control. This impairment of parental authority over the children has coincided with the complete assumption by the State of responsibility for their education. Yet indiscipline among young people, known as hooliganism, survives.

When the children leave school, they are exposed to temptations arising out of the conditions of modern industry; their labour is forthwith worth a good price in employments which give poor promise for the future. An evil of the present day is the high demand for juvenile labour in occupations for which there is a relatively low demand for adult labour.

At the tail of a van, or by running errands, boys may earn from 7s. to 10s. a week, while

if they enter a good trade, they must be content with low wages, and possibly provide a premium. When the boy grows into a man, and asks for man's wages he is dismissed, as his labour at man's wages is not wanted. Another boy takes his place. Every year a number of young men are thus thrown on the labour market unable to make anything or to perform any services which will procure them a full week's work. The facility with which a young man can get two days' work a week at good daily wages is demoralising. Idleness impairs his aptitude; permanent work grows irksome; he loses even the ambition to improve his position. The manufacture of the unemployed thus proceeds apace. It is hoped that by means of this scheme this "rake's progress" will be checked at the commencement. Accurate statistics are not available from which may be inferred the degree of protection against lack of employment which the knowledge of a trade affords. Experience, however, shows that the great bulk of the applicants to relieving agencies are of the unskilled and casual class. It is to be inferred, therefore, that protection against acute distress is gained either by knowledge of a trade or by the higher standard of living in respect of thrift and mutual aid which marks the more skilled workman.

The difficulty is aggravated by the industrial position of London, which, to quote Mr. Ave's words in "Life and Labour in London," vol. ix., by Mr. Charles Booth, "has no staple industry. ...... She is a great purchasing market for those resident elsewhere ..... and holds a unique position in a variety of ways in which she acts as a centre of distribution for home, colonial, and foreign products." This statement is borne out by the census of 1901, which shows that of males over ten years of age, 16 per cent. of the whole is engaged in transport and the carrying of messages, and 8 per cent. of the whole is engaged in commercial occupations. It is these very industries which use a specially large amount of juvenile labour.

An increase in the proportionate number of young people instructed in productive industries will diminish the supply of unskilled labour, both adult and juvenile. As regards unskilled adults, supply has outstripped demand, and a reduction in supply tending to greater regularity in employment will be an unmixed boon. As regards juveniles, the diminution of supply may lead to the resumption of adult labour in these branches of industry and to some other favourable readjustment.

The difficulty with regard to girls, it may be noted, is less pressing than with regard to boys. Partly because good trades for girls—specially the wholesale and retail clothing industries—are common in London; partly because a young woman who marries leaves, for the most part, an opening to which a younger girl may succeed. The married man, on the contrary, needs to increase his earnings, if it be possible, on his marriage.

Mr. Aves refers to a second characteristic of London: "Although much of London labour is unskilled and degraded, much of it is of the greatest excellence, and is being constantly recruited from the best workmen that the country can produce." The parasitic character of London industry is illustrated with reference to the building trade, the largest of London trades, in a report of the London County Council Technical Education Board in 1898, which stated that "41 typical firms in various branches of the building trades, having 12,000 *employés*, had only 80 apprentices and 143 learners, instead of 1,600 which would have been the normal proportion. The London building trades are, in fact, recruited from the country." This statement is confirmed by the census of 1901, which shows in Table 32, that in the building trades in London the percentage of males between 15 and 20 is only 8 per cent., while the like proportion in conveyance is 16 per cent. Further inquiry is needed into the causes which serve to qualify country bred men, and to disqualify London bred men for craftsmanship of the best kind.

These thoughts about the training of young people as it promotes growth in faculty, an increased production and more widespread employment lead to a consideration of the method of training through which these results are likely to be attained. Among the ways in which a child may enter his trade two are of special importance. He may be placed as an apprentice under an indenture which binds both employer and employed; or he may be placed with the employer as a learner unbound by articles. Interesting as is the past history of apprenticeship, it affords small guidance in present difficulties. The apprentice of old time lived in the house of his master, who was responsible for his training in both morals and craftsmanship. The apprentice of the present day lives, with rare exceptions, at home as a member of his own family, and goes daily to work. Out apprenticeship has grown up under modern conditions

of industry. It differs widely from its ancient namesake. Unfavourable features, criticised in apprenticeship of the past, are not inherent in it. "The essence," writes Miss Bradby in the paper which has been mentioned, "of apprenticeship is that it is a contract enforceable at law, between the master on the one hand to teach or have taught, and the boy on the other hand to serve. All else is incidental. There may or may not be a preminm to pay. The duration of the apprenticeship may be anything from one year to seven. The boy may serve all his time with one master, or permission may be made for him to serve several in succession. He may have no wages, or very small ones, the first year, or he may start with from 6s. to 10s. a week. What is fixed is that he cannot, "while the relations created by the indenture subsist, "change his trade or employer without the consent of that employer, while his employer cannot get rid of him or have him taught less than thoroughly."

Apprenticeship, therefore, is a prolongation of the period during which the youth or maiden remains bound in *statu pupillari*. It tends, as an addition to its advantages as a training in industry, to counteract the premature blossoming forth of boys and girls as men and women.

The learner, on the other hand, enters his trade unbound by articles. He starts for the most part as an errand boy to a firm where a skilled trade is carried on. The sharpest of the boys may be put to the bench and have an opportunity of learning the trade, but those who have average abilities or have no interest with the firm are apt to remain uninstructed. A boy, moreover, even if he be put to the bench is liable to be dismissed or may never learn important branches of the trade, or may be tempted by the offer of higher wages elsewhere to start prematurely as an incompetent workman. It seems, therefore, that in the interests of the children the method of apprenticeship, modified to suit present requirements, is greatly to be preferred.

Much else, however, is in question. The application of machinery, superseding handwork, and the increasing subdivision of employment are obstacles to the fulfilment of the notion of learning the trade right through. Moreover, the changes of method in manufacture are rapid, and no process now requiring skill of hand is safe from the invasion of machinery. The organisation of industry, furthermore, by large companies with general manager, managers of departments, overseers, and foremen, is not always suitable to the training of apprentices. It is important to recognise that these conditions of industry flow like the tide; they will not stay in the interest of any. It is wise, therefore, to decline to prophesy on the methods which may hereafter prevail in the trainlng of the young.

One thing is certain. A supply of suitable labour is indispensable to industry. The managers of industry, therefore, will find a way of securing it. The responsibility rests with them. Their industrial life, under competition within and without the country, is at stake. Nor is it likely that employers who remain permanently in London will acquiesce in the dependence of London on country-bred workmen. A skilled employment committee, therefore, will gather information and watch developments, eagerly seizing all opportunities in the interests of the children which present themselves in the existing course of business. It is, however, of cardinal importance that charitable people should refuse to influence the method of training by the offer of money. Employers should not be bribed to take apprentices, nor should parents be bribed to bind their children as apprentices.

If an employer be offered such a premium as he would not get except from charitable sources, he will be discouraged from taking apprentices except when such a premium is paid. The consequence, therefore, of offering such premiums may be to diminish rather than to increase the number of apprentices. Similarly, if parents be offered an equivalent for the reduced wages of apprenticed children, they are discouraged in placing their children unless such an equivalent be forthcoming. They lose the opportunity of making a sacrifice for their children's welfare. It is not suggested that such premiums should not be paid where the child is crippled or under other disability, and needs special instruction, or when the parent is a widow and cannot repay a loan or forego the better wages which the payment of a premium may command. Further enquiry is needed into the number of apprentices who are being taken with and without premiums in the several trades.

The consideration of the payment of premiums leads to a reference to the report issued by the London County Council on the Apprenticeship Question in January, 1906. This report is prepared by the Apprenticeship Section of the Higher Education and Scholarship Sub-committee of the Education Committee. It treats the matter, as may be expected,

mainly from the educational point of view. It emphasises the lack of facilities for the training of London boys and the consequent dependence of London on the country for superior artisans; "the better positions go inevitably to the country-bred man with his all-round training"; though it is "not prepared to admit that the Londoner is, on the average, inherently inferior either in intelligence or in manual dexterity. His unfortunate situation is due to lack of opportunity for industrial training and not to any innate infirmity incapable of cure." It seems strange that the report does not proceed to inquire into the methods by which the country-bred workman got his all-round training. It ignores the possibilities of indentured apprenticeship, and recommends the creation of scholarships, carrying free tuition and in some cases a maintenance grant tenable at evening classes, day classes, and day trade schools. The proposal of maintenance grants is not made without some disquietude. "In the United States and Germany it is, we are informed, rare for public provision to be made for the maintenance of scholars. It is, we feel, not altogether a satisfactory feature that in this country there should be less disposition on the part of the parents to make sacrifices for their children's advancement, and less willingness on the part of young people to exert themselves than in other countries." Will it not be well to ascertain by experiment whether parents be willing to make the necessary sacrifices before exposing them to temptation by the offer of maintenance scholarships? The experience of the committee in this direction is encouraging. However this may be, the suggestions of the report seem to be aimed at the development of talent in clever boys rather than the offer to all children, as desired by the skilled employment committees, of the opportunities of increasing their productive power. The report is, nevertheless, a valuable document in the cause of industrial training. It reports adversely and most wisely on the suggestion that public funds should be used for the payment of premiums. Such a use of public money would impair the responsibility alike of employers, of parents, and of those who seek to befriend the children.

The report, in the second place, recommends that the London County Council, as the educational authority, should co-operate with apprenticeship and skilled employment committees; the paragraphs of the report deserve to be quoted *in extenso*:—

"But undoubtedly the most beneficial results would be obtained by bringing the elementary schools themselves into closer touch with the various apprenticeship agencies. In many of the poorer schools of London there are children, known to the head teachers, who require assistance in finding a suitable opening. Much good could be done by acquainting the head teachers with the resources of the neighbourhood. At the present time several have made it a part of their duty to assist the children, in the way of finding them employment, as they leave school. This excellent work should be encouraged. The head teachers, who appeared before us, agreed that they would gladly make use of apprenticeship societies or outside agencies if they were furnished with information. We suggest that these charities should be classified according to areas, and that the head teachers (senior departments) of all elementary schools within such area should be furnished with the corresponding particulars. In order that the Council may learn the result of this action, we suggest that the head teachers should be asked to report, in October of each year, what steps they have taken to disseminate the information among the scholars during the preceding year, and whether any children have been apprenticed in consequence. It might also be useful to supply the head teachers with handbills for exhibition, containing particulars for openings for boys and girls about to leave school. A communication should also be sent to the several charities asking them whether the Council might be allowed to submit to the governing bodies suitable candidates. We are further of opinion that the information regarding apprenticeships should be supplied to the managers of the public elementary schools, and that among the duties of managers of the L.C.C. schools, a prominent place should be given to the duty of inducing the children to enter skilled trades as they leave school."

The report, as a further point, lays stress on the utility, for the purposes of technical instruction, of evening classes, day classes, and trade schools. These various methods of combining theory and practice have their respective advantages in the training of young people, who differ in grades of skill and in prospects.

It may be useful to summarise the points on which further inquiry is desirable in the interest of the future work. Some of them have been mentioned.

1. The ascertainment with reference to as many trades as possible of (i.) the conditions obtaining in them as affecting the moral and industrial welfare of those who enter them, and (ii.) the prospects which they afford of satisfactory employment for adults.

2. The ascertainment of the industrial history

of the children who have left selected typical schools during the past few years.

3. The ascertainment of the conditions under which young people receive industrial training in employments in which (i.) instruction is haphazard, (ii.) indentures are used, (iii.) indentures are not used.

4. Inquiry into the proper function of means of instruction other than the workshop, *e.g.*, classes and day schools.

5. The extent to which premiums are actually paid, (i.) by parents, (ii.) by charitable funds.

6. The proportion of country-bred men in selected London good trades and the causes of their superiority.

These inquiries should be made in the interest of the bulk of the children, and, so far as possible, from all persons interested, both employers and workmen.

It is clear from the account which has been given that the scheme to improve the industrial training of the young is itself young. It enjoys the vigour of youth. It makes large demands upon those who undertake it in the conduct of the necessary investigations, in digesting ascertained facts, and in rightly interpreting experience. It invites support and personal help. It offers to those who are minded to take part in it a practical and productive field of work. It is, moreover, rooted in a sound economy and a just interpretation of social facts. It is not casual and fortuitous. It has arisen in order to supply proved needs. Economic independence is the joint product of a man's capacity and willingness to contribute what is wanted to the common stock. An increase in such productive aptitude is the main aim of the scheme. In fulfilling this purpose it allies itself with those qualities which are alike the cause and the effect of independence in economic position; with strength of character, industrious habits, forethought, and the play of family affection. The work, therefore, has a well-marked place in the calendar of social service, and claims the sympathy and aid of those who value the traits which befit the free members of an industrial community.

APPENDIX.

List of trades in which children were placed in 1904-5-6:—

Boys.

Apprentices.—(1) Wheelwright; (2) Printing; (3) Motorworks; (4) Mathematical instrument maker; (5) Surgical instrument maker; (6) Engineering; (7) Pattern-making; (8) Plumbing; (9) Tailoring; (10) Bookbinding.

Learners.—(1) Tea-packing; (2) Engineering; (3) Bookbinding; (4) Stable-boy; (5) Foundry; (6) Draughtsman; (7) Chemical works; (8) Librarian; (9) Hospital porter; (10) Errand-boy; (11) Cork trade; (12) Service; (13) Candied fruit.

Girls.

Apprentices.—(1) Dressmaking; (2) Millinery; (3) Upholstery; (4) Artificial flowers; (5) Embroidery; (6) Feather-curling; (7) Relief stamping; (8) Box-making.

Learners.—(1) Collar-making; (2) Dressmaking; (3) Mantle-making; (4) Tie-making; (5) Artificial flower making; (6) Blouse-making; (7) Trimming-making; (8) Machining; (9) Book-folding; (10) Upholstery; (11) Costume machinists; (12) Millinery; (13) Tailoring; (14) Wholesale clothing; (15) Ready-made clothing.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said it was nearly 100 years ago since the Statute of Apprenticeship was repealed by the Legislature, and a remedy for the questions with which that Statute dealt was still being sought for. For many years there were few things discussed more than the question of apprenticeship. As far back as the twelfth century legislation on the subject was passed, and the Statute of Elizabeth, which prevented any person engaging in work who had not been apprenticed for six years, was the most important condition of the training of the young workman. Adam Smith opposed it strongly, first, on the ground that seven years was far too long, and secondly, that it prevented, by the restriction of the number of apprentices, large numbers of persons becoming good workmen who would wish to do so but who were unable to obtain apprenticeships. There was no doubt that, although it tended to a good sound teaching of a limited number of workpeople, it was not satisfactory in other ways, and that it produced a large and vagrant class. Adam Smith thought it was possibly for the benefit of the master and also for the benefit of the apprentice, but that it was not for the benefit of the public, who, he considered, would gain greatly by having the conditions of labour free and untramelled. There was no doubt whatever that the increase of English industry which occurred subsequent to the repeal of the Statute, was largely helped by the greater flow of workpeople into the common industries of the country. He did not think people realised how necessary it was that there should be a thorough and complete training of the young person who became an apprentice. At the time of the abolition of the Statute,

there were all over the country charities for dealing with apprentices, especially in London. Under the conditions of public opinion and the actions of the Charity Commissioners, the great bulk of those charities had been utilised for the support of technical education. They had now, at the end of 100 years, to consider what was to take the place of apprenticeship and to do its work more efficiently. There were several apprenticeship charities still existent. He himself was a trustee of the Campden Charity at Kensington, which formerly spent very large sums on apprenticeship, and it was now spending annually about £300 to £350 in that direction. It apprenticed a number of children who were born in Kensington at premiums of from £15 to £30 in each case, and the result had been on the whole extremely satisfactory. There was a large number of trades in which it had been possible to apprentice children; and he could not help thinking that, in the revival of the apprenticeship system under a new form in connection, to a large extent, with the evening schools where technical education was given, the help of such money as still remained allotted to apprenticeship, amongst the charities of the country, would be very useful. He would conclude by mentioning one fact to show that the parents and the children took an interest in the matter. A short time ago, when he was sitting as a magistrate to hear cases for compulsory attendance of children, a widow and a boy of about thirteen came before him. The boy absolutely refused to attend school, and when asked the reason, the boy replied that he was not going to school any more, as he wanted to be sent to an industrial school. He pointed out to the boy, that being sent to an industrial school was a punishment; he would be under very strict discipline, and, to a certain extent, there would be a stigma against him, but the boy replied that if he remained as he was, he would never be taught a trade, whereas if he was sent to an industrial school he would be taught one.

Mr. H. V. TOYNBEE thought there was a very common impression in some quarters that apprenticeship was practically non-existent at the present time, that being the general drift of the argument in the report of the Education Committee of the London County Council, and various suggestions were made to take its place by which skilled trades could be taught. It was a question whether apprenticeship was so obsolete as was sometimes imagined, and, consequently, whether any other system could be devised by which a trade could be thoroughly taught. The Jewish Board of Guardians, when they desired to give the children who came before them a good industrial start in life, turned to the apprenticeship system, and in 1905 they apprenticed over 400 children, having up to that time under their care 1,000 boy and girl apprentices. The East London Apprenticeship Fund had apprenticed about 800 boys and girls, and if it had had a larger income would have apprenticed more. A committee in South London, connected with the Women's University Settlement, had apprenticed in quite a short time 150 boys and girls, and similar work was being carried on by apprenticeship committees throughout the whole of London. In the Admiralty dockyards, and in all the various departments of shipbuilding and engineering, the hands were trained by means of apprenticeship, plus compulsory attendance at technical classes. The same remark applied to the Great Western Railway carriage works at Swindon, and many other undertakings. In the printing and plumbing trades the dearth of skilled workmen became so acute that a joint movement was made by the masters and representatives of the trade unions to improve both the trades, and an apprenticeship board had been started in order to encourage it. As time went on it became increasingly easy to find openings for apprentices, and he thought he had shown that apprenticeship was still very largely in existence. The part that apprenticeship committees was playing was one of extreme importance, but up to the present time their work had not been sufficiently recognised. They acted as connecting links between the elementary schools on the one hand, and the employers of labour and various apprenticeship charities on the other. In his opinion the most important part of their work was the after-care of the apprentices, in seeing that the conditions laid down by the indentures were carried out. Of the various ways by which a skilled trade could be taught, he thought indentured apprenticeship, coupled with attendance at technical classes, was the most satisfactory. Without indentures he did not believe it was possible to secure, either that the child was thoroughly taught his trade, or that the master made provision for him to attend technical classes. His experience at Southwark had been that masters were ready to agree to a clause being inserted in the indentures by which a child was allowed to attend technical classes without any loss of wage. Two alternatives were generally suggested for the apprenticeship system, one being the part-time system and the other the system of trade schools. Under the former, the child spent a portion of its time in the workshop and the remainder in the technical school. He did not think that did away with the necessity for indentures, because without them the child might be made a drudge; there was no guarantee that the trade would be thoroughly taught, and the master might rely on the technical classes for the child learning the trade. He thought the part-time system might be a useful adjunct to the apprenticeship system, but he did not think it was a substitute for it. Excellent as the teaching was in the trade schools, he did not think it could be compared with that to be obtained in the workshop, where goods are made under ordinary trade conditions for profit. Admittance to trade schools also was by means of scholarships, for which there was keen competition, so that it was

only the sharpest children who had a chance of being successful. The schools did not cater for the mediocre boy or girl, and that class composed the largest number. To set up trade schools all over the country would be a costly matter, and that in itself ought to form a strong argument for not putting aside the apprenticeship system. With regard to the question of premiums, he thought the endowed charities, in London at any rate, might with very great advantage be amalgamated and administered under one Board, because it was found that in some parts very considerable charities existed and not many applications were made for them. There were other ways by which premiums could be secured. For instance, he did not see why the child should not be encouraged to save money whilst at school in a school savings bank, so that a sum of money should be available when he left for the purpose of his premium. There was no reason either why insurance should not be applied to the matter; in fact, he recently came across a woman who had deliberately insured each of her boys with the idea of obtaining a lump sum at the age of 14 with which to apprentice them. He suggested that the County Council, instead of exclusively encouraging trade schools, as they appeared to be doing, should also see whether they could not develop the apprenticeship system adapted to modern conditions.

Professor W. E. DALBY said that his knowledge of the subject was limited to the engineering branch. A friend of his, who owned a large manufacturing engineering business in London, made it a practice to ask the headmasters of the Board Schools in the district to keep him informed of the best boys that they had at the end of the year's course, in order that he might give them a chance in his works. That gentleman regularly recruited his works with apprentices of that class. He thought it would be a very great help to employers if, at the time the masters gave the educational qualifications of the boys, a note was placed on the card index giving particulars of their manners, which were very often deficient. In connection with the number of trades to which it was possible to apprentice youths, he very much regretted that in the engineering metal work trade much of the old handicraft skill was dying out. It was only necessary to look at the specimens of iron work in South Kensington Museum, such as armour, to appreciate the fact that it would be quite impossible to obtain such things in this country at the present time. That was largely due to the introduction of machinery. In the engineering trade especially, the effect of the introduction of labour-saving appliances had been to drive out the old-fashioned millwrights. Practically no millwrights, men who could go into a shop and turn their hands to every sort of work, were now being trained. The whole tendency of the present day was to specialise, and he was afraid it would be very difficult, especially in engineering, to avoid the apprentices being simply put to mind machines to start with. In an engineering shop nowadays it was almost a crime to use a file on anything, it being the rule that everything must come from the machine, and be put together without any handicraft skill at all. Anything which would tend to reintroduce a scheme which would increase the handicraft skill of the country would be of undoubted benefit. A large number of railway companies were realising that it was important to combine technical instruction with the ordinary apprenticeship but it was very rarely indentured apprenticeship, the boys being taken on, and called apprentices. At Crewe, Harwich, Swindon, Stratford, Doncaster, and all the large engineering centres, there was a tendency to allow the apprentices to go to the technical institutions connected with the works so many afternoons a week, their wages not being stopped. In Stratford, in particular, after attendance at the institution for two or three years, the directors selected the three best men, and paid their fees at some technical college for a course of two years. That had only been brought about in the last few years, and indicated a very great change of attitude on the part of the employers to apprentices. The author struck the right note when he said that the situation was in the hands of the employers. It was the employers to whom they must look to take the products of the technical colleges, and the question would never be solved until the employers as a body co-operated with the schools and chose the best boys, rather than trust to the haphazard applications that were made to them for such places as they had to fill by apprentices. The author had brought forward a general scheme for establishing a kind of employment bureau between the schools and the masters of different trades. That was felt to be a great need at Cambridge University a very few years ago, and an employment bureau had now been established there. When June came round every year, he found that one of his chief duties, in connection with the department over which he presided at the Central Technical College, was to deal with the appointments that students were trying to obtain by fitting the employer to the student. That showed the need for some central bureau or employment agency which would bring the two classes together; and if the Employers' Federation of London could be approached and brought into co-ordination with the schools and colleges, a great step in the right direction would have been taken.

Mr. MYERS said, having had thirty years' experience of apprentices in London, he desired to call attention to the difficulty which had been experienced during that time in finding suitable masters for the apprentices. The difficulty was to make apprenticeship popular with the employers. The Jewish Board had always had a very large number of boys anxious to be apprenticed, but had never been able to obtain

a good supply of masters. Two canvassers were permanently occupied in searching every part of London to find people who were willing to take the boys, and advertising was freely resorted to, but the difficulty still existed. The number of boys willing to be apprenticed was unlimited. The author probably knew that the Jewish Board had to stipulate that the lads should not be employed on Saturdays, and it might be thonght that that was the cause of the difficulty they laboured under. No doubt it was a difficulty, but he did not think it sufficiently accounted for the paucity of masters. If something could be done to popularise the idea with employers, many more indentures would be carried through. He thought the Jewish Society might be considered the pioneer in the revival of apprenticeship. It had at present under its care about 900 boys and girls. Curiously enough it found there was not so much difficulty in apprenticing the girls as the boys, an increasing difficulty being experienced in getting the boys apprenticed without the payment of a premium.

Mr. ISAAC MITCHELL, L.C.C., thought the subject could be approached from two points of view, the first of which had been dealt with by the last speaker. The Jewish organisation was on the look out, with the limited means at their disposal, for employers who would train boys and girls. That might be extended to some extent, but obviously it was impossible to include all the boys and girls that were being educated under that particular head, although it was certainly beneficial to take the boys and girls from their surroundings where they would not learn any special trade and, by the payment of premiums, train them up to a particular trade. But that was not the problem which had to be solved. It was necessary to devise some means whereby girls and boys would not be thrown upon the world when they were 14 or 15 years old, but would have their education continued after they left the elementary school, by imparting to them knowledge of some particular branch of industry. That was a big problem, which he was confident would never be solved by the revival of the old apprenticeship system. He believed the revival of the system was as dead as the Irish or the Scotch languages. there being just as little need for the training which was given under the old apprenticeship system as for the revival of those languages. Nowadays, in engineering shops, the apprentices did not learn the trade right through, because the employer did not want millwrights; he had so specialised his industry that he wanted a lad to acquire a knowledge of only one particular branch of the business, and therefore, from an economic point of view, he would not teach the lad anything but that one particular point. Working people at the present time wanted to produce as much wealth with as little labour as possible. Another phase of the problem was, that he did not think it would be possible to train lads in the bulk for any special industry without having a detrimental effect upon the people already in the trade. It had been said that there were practically no apprentices in the London building trade; but if all the lads who were working on the tails of vans had been apprenticed to the building trade, instead of 10 or 12 per cent. of those who followed the occupation being out of work the number would be 25 per cent. Something had to be done to maintain the men who followed a particular branch of industry in employment; and unless another side of the problem was tackled, he was confident that the evils of unemployment would be increased in particular trades if they were flooded with apprentices The only solution of the problem which he could see was in the direction foreshadowed by the report of the London County Council, whereby the children's education was continued beyond the age of 14 or 15 up to 21 years of age, the children not being placed upon the industrial market until they were fully equipped with a knowledge of certain branches of industry. If that were done, and the hours of labour also dealt with, there was a possibility that openings would be made in the direction the author of the paper desired.

Miss ADLER thought that one of the chief difficulties experienced was that of procuring really good teaching for the boys and girls as apprentices. It was of extreme value to have various methods of training going on side by side, and, therefore, she welcomed the formation of apprenticeship committees in different parts of London. At present there were not sufficient facts and figures to go upon; but in five or six years time, when the boys and girls, who had been apprenticed, were able to give their experiences, they would know what system should be adopted. With regard to the question of apprenticeship, and attendance at technical classes in the evening, the hours of labour for young people were so long, that it was impossible to hope they would be in a condition in the evening to deal with difficult points connected with mathematics or other branches of science which had some bearing on their training. If technical and workshop training was to go on side by side, every effort should be made to induce the employers to give time off during the week, so that undue stress should not be placed on the children. She thought Mr. Toynbee was a little unjust to the trade schools. They were a somewhat expensive development; but if in the result, they combated unemployment she thought no expense should be spared to benefit the economic conditions of the men and women of the future.

Mr. E. BRUCE said that he was not an advocate of the return to the old system of apprenticeship. In the old days, many of the masters simply took the boys for the sake of the premium they obtained with them, and the boys were very little better at the end of their apprenticeship for their so-called training. He had

seen something of the work done by the University Settlement in Nelson-square, and knew that the lads who were apprenticed grew up to be self-respecting young men, taking an interest in their work and lives. One of the most valuable features of the system was the visits that were paid to the employers and the parents for the purpose of seeing that the boys were actually taught their trades. There had always been a difficulty in poor districts in getting boys to go as apprentices, because the parents only considered the prospect of an immediate 7s. or 8s. a week, as against a smaller amount in the case of apprenticeship, and the parents argued that they could not afford to lose the money. He strongly objected to the suggestion that public money should be used for the payment of premiums, and thought that as a rule the work should be self-supporting. The parents should be made to feel that they owed some duty to their children. A suggestion had been made that the manners of the elementary schoolboy were not immaculate. The manners of the schoolboy were not learnt at school but at home; and although the elementary school teacher had a great influenee over his children, generally speaking he could not counteract the great influence of home life. With regard to the suggestion that the County Council should secure the co-operation of head teachers, he did not think they would object to doing the work, but he asked the members of the Education Committee not to give them any more forms to fill up if they could possibly help it.

Mr. C. A. BUCKMASTER thought there were one or two matters upon which his experience of work in connection with the technical branch of the Board of Education in different parts of the country might be of some use in regard to the problem in London. He had found that apprenticeship charities, were, as a rule, not properly applied. The difficulty of finding suitable employers, especially in small districts, was a very great one, and it often happened that money left for apprenticeship premiums was practically thrown away. An employer required assistance and would be glad to pay for it, whereas owing to the existence of these charities, he was paid for doing what he would otherwise be glad to pay for himself. When a state of affairs existed in which apprenticeship premiums were paid to a parent for the training of a boy in his own trade, he thought it it would be admitted that charity money was in very great danger of being misapplied. He agreed with Professor Dalby that, so far as he could ascertain, indenture apprenticeship was practically non-existent in the big engineering trades. The railway companies would not take indentured apprentices, but only premium apprentices. There were very few employers who would stand out against an offer of £100 or £200 with a premium apprentice, but for the rank and file of the workers there was practically no indentured apprenticeship, and certainly no agreement to teach every part of the trade. As a result, indentured apprenticeship tended more and more to throw the apprentice into employments in which there were only a very small number of persons, and with small masters rather than big employers. There was another point in which the relation of the workshop and the technical school was worth considering. One of the most important duties that the trade school could perform was to give the apprentice an insight into some of those branches of the trade which the subdivision of labour did not give him the opportunity of learning in the workshop. In the technical schools all over the country, employees in different trades very frequently came to learn one or two parts which they could merely see at a distance in the factory, and in that way the technical schools were able to give an all-round knowledge of the trade, which was so desirable if the bugbear of unemployment was to be reduced to its lowest level. The enormous difficulty of the problem was realised when one considered that even with the numbers given by the author, they were only dealing with the very fringe of the subject. Only a very small percentage of children were being taught a skilled trade; but the ultimate end they had in view was to secure the whole of the population of the country who had not been taught a trade of their own. Anybody acquainted with unemployed committees knew it was a common fact that 95 per cent. of the applicants were unskilled labourers, and until that was done away with it was possible to consider that the system of training persons was being properly carried out. As an historical fact, it might interest the author to know that no less than 40 years ago the apprentice charities of Battersea had in their indentures a clause requiring the employer to allow his apprentice to attend science or technical classes, for the purpose of improving himself in the theoretical branches of his trade.

Mr. ALFRED MILWARD said there appeared to be a general idea that the apprenticeship system was failing, but it had been very successful in the Poor-law Schools of St. Pancras. The Guardians of St Pancras apprenticed boys or girls, paying a small premium of £6, the first half being payable on the signing of the indentures, and the second at the end of the year, if everything was satisfactory. An allowance, in addition to the premium, of about £3 10s. was made for the purchase of an outfit. Most gratifying results had been obtained, in some instances the boys becoming so proficient in their trades that they had set up for themselves, and had taken apprentices from the same schools in which they were brought up. The boys who were placed out under the Poor-law system had the great advantage of being looked after by the Association for Befriending Boys. That society had reported upon 151 boys placed out by the guardians of St. Pancras, and in the majority of cases the results were satisfactory.

The boys had nearly 12 months training in the schools in the particular trade to which they were eventually apprenticed, and being residential schools they had the advantage of learning the elementary parts of their trade whilst they were at school. It was undoubtedly the fact that, in many cases, the Poor-law children had advantages superior to those possessed by the children of any of the ratepayers. Most of the apprenticeships were indoor apprenticeships, but in some cases outdoor apprenticeships had been arranged, the boys being placed with a family, and their earnings being supplemented for a short time by the Guardians.

Mr. PARSONS, in reply, said he particularly wished to refer to Mr. Mitchell's remarks, because it was most important that the leaders of the working classes should be in sympathy and harmony with the movement; in fact it would be impossible to carry it through unless that state of things was brought about. Mr. Mitchell seemed to fear that, if the movement largely increased, the prospects of the existing working-men would be injured. He had given a great deal of study to the subject, and sincerely believed that such an argument was a complete fallacy. Nothing could be better for the whole of the working-men of the country than that its productive capacity should be increased. Mr. Mitchell seemed to think that a large number of people would be produced who had all been brought up to the same trade, the illustration which had been used being that if a great many more boys were apprenticed to the building trade the per-centage of unemployed would be increased. It was important to show, as he had carefully done in the paper, that, from the necessities of the case, it was necessary to cover a very wide area of trades. For instance, in the small scheme with which he was connected, 91 children had been apprenticed to 40 different trades, so that it was quite clear there would be no danger of swamping any particular trade. The only way in which the children could be taken on was through the employer; he would not take them on unless he believed the undertaking would be a success. These facts seemed to constitute an automatic check on the undue invasion of any trade. He earnestly hoped that Mr. Mitchell and his friends would seriously consider the proposition he (the speaker) put forward, viz., that an increase in the productive power of the country would be of benefit to all.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Parsons for his interesting paper, said that in connection with the Campden charities of Kensington, 142 children had been apprenticed to 32 different trades, figures which supported the contention that the apprenticeship system which was adopted covered a large area of trades.

The resolution was carried unanimously, and the meeting terminated.

GOLD MINING IN ASIATIC COUNTRIES.

Of the total gold yield of India, the Kolar Field in Mysore furnishes 99 per cent.; the only other producer from lode mining, outside of this small area, is the Hutti mine at Hyderabad, owned by the State. The output of the gold-producing States in 1905 was, according to the Geological Survey of India, as follows: —Mysore, £2,363,457; Hyderabad, £50,060; Burma, £2,419; Punjab, £703; Bombay, £320; and the United Provinces, £7; total, £2,416,966, as compared with £2,366,079 in 1904. The total yield of the Kolar Field in 1905 was 627,700 ounces of bullion (564,930 fine ounces), an increase of 4,012 ounces over 1904. The five leading mines together furnishing 98 per cent. of the field's output are the Champion Reef, Mysore, Ooregum, Nundydroog, and Balaghal, all of which are of importance; and, in addition, there are the Mysore West and Mysore Wynaad mines, which showed a good return in 1905. The Champion Reef, according to a report in "The Mineral Industry in the United States and other Countries," finds itself in the unaccustomed position of having to combat with poor zones of ore. The mines in the Kolar goldfield have repeatedly had to go through this ordeal. The Mysore mine had this experience at a very early period of its history, but quickly recovered. On the other hand, the Coromandel has spent many years in exploring for paying ore bodies. Ooregum and Nundydroog passed successfully through the trying time at about the middle of their present career. The Champion Reef mine, during the year ended September 30th, 1905, crushed 215,167 tons of ore, an increase of 33,219 tons over the preceding year. The year's output of bullion (216,802 ounces) was obtained thus:—188,596 ounces from the batteries, 2,617 ounces from No. 2 mill (now dismantled), and 25,589 ounces from the cyanide plant. The cyanide treatment is being curtailed; 177,000 tons of sand were cyanided in 1905. The employment of electric power secured from a number of independent generating stations has reduced the mining and milling costs by 4s. 4d. per ton, these two expenses having totalled £1 3s. 3d. per ton milled in 1905. The average yield is said to have declined from 1 ounce to 0·87 ounce per ton, which was to be expected in the increased tonnage milled. The records of the Geological Survey of India call attention to the Hutti mine, in the Nizam of Hyderabad's dominions, as still continueing to give good results, the output since the mine began to produce gold, in March, 1903, having been as follows:—1903, £14,505; 1904, £40,624; and 1905, £50,060. Another mine in the neighbourhood of Topaldodi has been opened, but it has not yet given any returns. In Burma, prospecting is still going on in the Chindwin river, and preparations have been made for starting active dredging operations on the Namma river in the Northern Shan States. The gold obtained by dredging in the Irrawaddi, in the Myitkyina district,

increased from 216 ounces in 1904 to 620 ounces in 1905, a second dredger having been got to work in the latter year. Only one of the Dharwar mines has so far given any results. In 1905 as compared with 1904, there was a decrease in the production of gold in the United Provinces and the Punjab, where the industry is entirely confined to native gold washing, said to be due to the light rains of 1905. In Kashmir also the production fell off greatly, from about 26 ounces in 1904 to only 10 ounces in 1905. The gold is derived from terraces in the Indus Valley in Kargil and Skardu. The Chota Nagpur gold washing is mainly confined to the valleys of the Karkari and Suvarnarekha rivers. The number of persons engaged in the industries fluctuates considerably as the people do not depend entirely upon it for a livelihood. In Manbhum the number employed was 255, and in Singhbum 154. In Corea, English, Japanese and American companies are engaged in gold mining. The largest of these is the Oriental Consolidated Mining Company of New York. This company owns six mines, five stamp mills and three cyanide plants, and leases three other mines. During the year ended June 30th, 1905, the company mined (including 2,826 tons of tribute ore) 257,647 tons of ore. This ore yielded in bullion and from sulphurets £202,000. Milling of the above output cost 2s. 4d. per ton, in which the cost of cordwood alone came to 1s. per ton. The five mills comprise 200 stamps; they ran for 320 days in the year and crushed four tons per stamp per day. The cyanide plants treated 32,556 tons of sulphurets, extracting 75·8 per cent of their gold, discharging tailing worth 3s. 3d. per ton. The cyanide treatment cost 5s. per ton handled, the cost of cyanide alone coming to about 1s. 10d. per ton. Ore reserves at the company's mines on June 30th, 1905, were estimated at 1,068,447 tons, a diminution of 23,355 tons during the year, occasioned entirely by a lack of labour. The Corean Government has been requested by the Japanese to grant permission to Baron Shibusawa and another Japanese to work the gold mine at Hamehung, in the province of Hamgyongdo. In Japan the gold mining industry is fostered by the Government, which itself works the recently discovered veins in the Iwate field. The chief placer deposits are in the Esashi district, Hokkaido. The principal vein mining centres are in the Echigo, Satsumo and Iwate districts. The chief mines are the following:—Innai, Kosaka, Sado, Hashidate, Tase and Kanagase, Kuratani, Taio, Hazami, Serigano, Okuchi, Ushio and Yamagano. The greatest output is obtained from the Kosaka, Sado, Yamagano, Ushio, and Tase and Kanagase mines. The value of the fine gold produced in Japan in 1903, the latest year for which the data are available, was £428,058, exclusive of Formosa. In the Malay States, the results of gold mining during 1904 do not appear to have been brilliant. The quantity obtained from crushings was 12,625 ounces from 54,961 tons in Pahang, and 2,189 ounces from 3,438 tons in Negri Sembilan. In addition, 146 ounces were obtained from alluvial washings and 2,115 tons of tailings by the cyanide process.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in November, 1906 :—

New Charts.—3613 - The World:—Mean lines of equal vertical force, 1907. 3564 - Scotland, west coast : - Loch Kishorn and the approaches to loch Carron. 1448 — Spain, south coast : — Acebuche point to Chullera point, including Gibraltar bay. Plan : — Algeciras roads. 3609 — Sardinia, north-east coast : — Port Terranova. 3583—Newfoundland : —Bay of Exploits, sheet V. 3610—Magellan strait : —Willes, Harriss, and Fox bays. 3611—Plans on the south coast of Sumatra : — Zutphen islands; Kiluang bay. 992—Japan :—Akkeshi wan. 3602—Anchorages in Yezo island :—Mombetsu anchorage; Mori roads.

New Plans and Plans added.—98—Plans on the south coast of Cuba. Plan added : — Puerto Francés. 1364 – Africa, west coast, cape Mesurado to Baffu bay. New plan :—Junk bay. 71—Bay of Bengal, Madras to Calimere point. New plan :—Pondicherri anchorage. 1495—Japan :—Aburatani bay to Ando zaki. Plans added :—Shichirui ura ; Yunotsu ura ; Yesaki ko. 2198—Harbours and anchorages on the north coast of Nipon. Plans added :—Yezumi ura ; Sagi ura. 3003—Japan :—Ando zaki to Otose zaki, including Sado island. New plans : — Niigata ko ; Ogi ko. Plans added :—Tsukumo wan ; Yebisu ko ; Naoyetsu ko. 3131—Anchorages in New Hebrides islands. Plan added :—Narovorovo.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners :—2390 — Scotland, west coast :—East and west lochs Roag. 2729—Ireland, west coast :—Sligo and Ballysadare harbours. 2210—Black sea, Plans in. 3206—Antartic ocean, Sheet VIII. 566—Iceland, eastern portion. 2980—Iceland :—Storksnaes to Portland. 2343—San Domingo :—Samana bay. 1982*b*—South America, east coast : —River Paranà, Sheet II. 516—Mexico, south-west coast :—Mangrove bluff to cape Corrientes. 3313—Alaska : — Yakutat bay. 654—Alaska :—Bering strait. 1363—Africa, west coast:—Sherbro island to cape Mesurado. 833—Bay of Bengal :—Rangoon river and approaches. 1180—China, east coast :— Approaches to Hong Kong. 1466—China, east coast :—Hong Kong. Fotaumun pass. 2412. Japan :—Amoy to Nagasaki. 2924—Australia, east coast :—Cape Grafton to Hope islands.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

The Port of London.—In June, 1900, a Royal Commission was appointed to inquire into the subject of the administration of the Port of London. In June, 1902, the Royal Commission submitted their report. Paragraph 253 runs as follows:—"It has, in our opinion, been proved that the Port of London is in danger of losing part of its existing trade, and certainly part of the trade which might otherwise come to it, by reason of the river channels and docks being inadequate to meet the increased and increasing requirements of modern commerce." And the concluding paragraph of the report has the following:—"The Port has for a time failed to keep pace with the developments of modern population and commerce, and has shown signs of losing the position relating to other ports, British and foreign, which it has held for so long." The report recommended various drastic changes and the expenditure of some £7,000,000; £2,500,000 estimated to be necessary for permanent improvement of the river, and £4,500,000 for the improvement and extension of the docks. The additional capital required to meet these charges and the necessary cost of maintenance and working expenses might be, in the opinion of the Royal Commission, provided, so far as the £2,500,000 was concerned, by the municipal authorities, the Port Authority finding the £4,500,000 by the issue of Port stock. Nearly five years have passed since these recommendations were made, but little has been done towards giving them effect. The late Government intended to do something, but did nothing; and the present Government has given no indication of its intentions. Meantime the years pass, and the need for improving the river channels aud the dock accommodation becomes more imperative. It cannot (if Liverpool is excepted) be said that absolutely or relatively the Port of London has in the years that have passed since the Royal Commission reported "shown signs of losing its position relatively to other (British) ports." Taking the four leading ports the figures are as below:—

Year.	Imports. Tons.	Exports. Tons.
	London.	
1900	9,580,864	7,119,673
1904	10,788,212	7,850,947
	Liverpool.	
1900	6,001,563	5,666,145
1904	7,986,584	6,730,206
	Tyne Ports.	
1900	4,871,427	6,407,089
1904	4,805,067	6,589,972
	Cardiff.	
1900	5,132,523	7,636,717
1904	4,795,406	8,324,066

The tonnage entering the Port of London to-day, is much larger than when the Royal Commission reported. The growth of London itself as a market for goods tends to increase the trade of its port, but the competition of the newer ports, British and foreign, grows keener, and if the Port of London is to continue to hold its own, some such improvements as those indicated by the Royal Commission must be effected within the next half a dozen years.

The Dock Companies and the Port.—The delay in undertaking the improvements suggested by the Royal Commission has been mainly due to uncertainty as to what the Government propose to do, but this delay, and the pressing need for improving the river channels and dock accommodation, have induced the dock companies to move to obtain a remedy, and the London and India Docks Company will promote a Bill in the coming Session of Parliament. It deals principally with the deficiency of dock accommodation, and the financial difficulty. One clause would enable the company to impose dues upon all goods imported from beyond the seas. Under the scheme of the Bill it would be necessary to raise £350,000 a year, and that would require an average of about 9d. per ton on all foreign goods entering the port. Another clause would enable the company to collect from barges entering the docks, 3s. 6d. for each barge of under 100 tons, and 5s. on each barge in excess of that tonnage. In this matter of barges, the Port of London is under distinct disadvantages as compared with other ports. The dock companies may not charge for the use of their docks as such. It is estimated that 80 per cent. of the cargo loaded into ships in the docks is brought alongside in lighters, and 75 per cent. of the cargo discharged in the docks is taken away in the same manner by the consignees. The statutory exemptions in the Dock Acts secure to lighters the free use of the waters of the docks, and so the companies obtain no revenue from dues on goods so brought in and taken out. The Royal Commission recommended that the Port Authority should have power to levy a licensing fee, according to tonnage and description, upon all barges using the port, and plying in the river, or in the docks, or in both. A meeting of London shipowners was held a few days ago to consider the Bill referred to above, and a resolution was passed calling the attention of the Government "to the fact that nearly seven years have now elapsed since the Royal Commission to inquire into the Port of London question was appointed; that the long delay in legislating upon the subject is causing serious injury to every interest concerned in the Port of London," and expressing the hope that, subject to modifications, "His Majesty's Government will use its influence to secure the passing" of the Bill under discussion "during the Parliamentary session of the present year." It is already evident that the clauses relating to the dues will meet with strenuous opposition, but whatever the fate of this particular Bill, it is to be hoped that the improvement of the Port will not be much longer neglected. Where all agree as to the need, there should be no insuperable difficulty in arriving at agreement as to the means.

Insurance.—1906 will be long remembered by the managers of insurance companies for the unprece-

dented losses incurred by them owing to the fire at San Francisco. Hitherto no British fire office had been required to pay more than two-thirds of a million sterling as the result of any one fire, and only one office, the London, Liverpool, and Globe, which in 1871 was the greatest sufferer from the Chicago fire, had reached these figures. But the San Francisco fire meant the loss of £1,000,000 to several of the British offices, whose aggregate losses exceeded £10,000,000. The financial strength of the British offices was demonstrated by the way they met their San Francisco engagements. Only one, a comparatively small office, found it necessary to make a call on its proprietors; some met their losses entirely out of balances carried forward in their profit and loss accounts, and the rest found their other reserves ample without calling upon their proprietors. Without exception the British offices concerned met their obligations promptly and in a generous spirit, and it can hardly be doubted that their business in America will show considerable expansion, unless, indeed, Congress accepts the Bill under which it is proposed to levy a tax of 5 per cent. of the gross premiums received in the United States by all foreign insurance companies doing business in that country, which is hardly likely. Apart from San Francisco, the business of the British fire offices in 1906 was good. At Valparaiso they were protected against loss, as is the case at Jamaica; and it is to be assumed that in the United States the new policies will protect them against loss, not only directly but indirectly, caused by earthquake.

The Shipbuilding Output.—The figures for the past year are now available, and show a large increase in the output of new ships as compared with 1905. In that year the tonnage amounted to 1,805,968 tons, as compared 2,002,571 tons in 1906. The Clyde heads the list with 598,846 tons, as against 539,850 tons in 1905, the Tyne coming next with 411,569 tons, as against 338,645 tons in 1905. Then follow the Wear, with 334,572 tons, and the Tees and Hartlepool with 292,344 tons. Taking the three kingdoms, England heads the list with 1,193,881 tons, as against 1,073,309 tons in 1905. Scotland is second, with 658,139 tons, as against 587,932 in 1905, Ireland coming far behind with 149,860 tons, as against 144,727 in the previous year. 1906 was notable not only for its record output but for the launch of the largest merchantman ever put into the water, the Cunard steamer *Lusitania*, of 33,000 tons, built by Messrs. John Brown and Co., Clyde Bank. The activity of the shipyards in 1906 largely accounts for the domestic demand of the year for iron and steel of all sorts.

The State of Trade.—Reference was made in these Notes last week to the Board of Trade returns with their record figures showing an increase of 43,000,000, or 7 per cent. in imports, and of 53,000,000, or 13 per cent. in exports, and it was pointed out that the increase in quantities was not so pronounced as would appear from the mere values, yet they were none the less satisfactory. In his usual half-yearly review the Chairman of the Union of London and Smith's Bank emphasised this point, and went on to remark that high prices of raw material affected the manufacturers' profits considerably, and must tend to decrease their output, so that the profit derived from this large volume of trade may not have increased in proportion. There can, however, be no doubt that 1906 was an exceptionally good year for the working-classes. Whereas the prices of raw material, especially minerals, rose considerably, employment improved, and the prices of articles of food were either less or rose only very slightly. The prospects for the coming year too are very hopeful. Sir Felix Schuster says that from all the centres in which his bank is represented reports come full of promise as regards the future, and this is especially the case in the north. There is general and remarkable activity. In some places there is scarcity of labour where work is going on day and night, and so far as the export trade is concerned there is great activity. It is less with the home trade but it is hoped that this too will improve. But it is becoming every year more apparent that only those who are up-to-date and alert can succeed. Even farmers are doing better. There is only one considerable trade that remains depressed—the building trade, which is slack or stagnant, slackness which may be attributed largely to over building a few years ago, and probably in some measure to the effect on the smaller tradespeople of high municipal rates, and a heavy income tax.

The Home Demand.—The weak point in the industrial outlook which on its face seems so promising is the state of the home market. Trade is good, but it is the export trade, not, as in the case of our great rivals, Germany and the United States, the home trade. In those countries the enormous home demand is occupying practically the whole attention of manufacturers, whereas here, if it is not stagnant, the improvement is slight. The demands of the American and German home markets have helped British manufacturers by relieving them from foreign competition. They have indeed been supplying our most formidable competitors with materials, but what when supply has overtaken demand abroad? Note the sharp break in pig-iron warrants.

OBITUARY.

ALLAN WYON.—Mr. Wyon, who held the office of Engraver of H.M.'s Seals from 1884 to 1901, died at his residence at Hampstead on January 25th. He was born on July 4, 1843, and educated at King's College School, London. He was the son of Mr. Benjamin Wyon, and he belonged to a family of medallists. An ancestor of his came over from Germany as Court goldsmith to George I. Among

other works he executed the Royal Jubilee Medal of 1887, Episcopal Seals for the Archbishops of Canterbury and York, the Great Seal of Ireland in 1890, and the Seal for the Secretary for Scotland in 1889. He was elected a member of the Society of Arts in 1892, and on November 29, 1899, he read a paper on "The Great Seals of England." For many years the Society's medals were produced by the Wyons. Amongst others, the die for the Albert Medal, with the bust of H.R.H. the Prince Consort, was the work of his firm.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

FEBRUARY 6.—"The Principles and Practice of Insurance, and their modern Developments." By THOMAS EMLEY YOUNG, B.A., Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association. H. J. MACKINDER, M.A., Principal of the London School of Economics, will preside.

FEBRUARY 13.—"Motor Omnibuses." By LORD MONTAGU OF BEAULIEU.

FEBRUARY 20.—"Cold Storage and Food Supply." By HAL WILLIAMS. SIR EDWARD MONTAGUE NELSON, K.C.M.G., will preside.

FEBRUARY 27.—

MARCH 6.—"The Discovery of the South Eastern Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S.

MARCH 13.—"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

Dates to be hereafter announced:—

"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Engraving and Photogravure." By. J. CRAIG ANNAN.

"Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts.

"Hungarian Arts, Home Home Industries and Commerce." By LOUIS FELBERMAN.

"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon.

"Aerial Navigation." By MAJOR B. F. S. BADEN-POWELL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

FEBRUARY 14.—"The Practical Side of Famine in India." By SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., late Chief Commissioner of the Central Provinces. THE RIGHT HON. LORD CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., will preside.

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. This paper hus been unavoidably postponed from February 19th.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

LECTURE II.—FEBRUARY 4.—*Lode Mining.*—The term "reef" used both for ore and "country" rock—The chief types of gold-bearing lodes—The importance of ore genesis in reference to mine development—The chief gold fields of the world and their structures—The Rand and its banket.

LECTURE III.—FEBRUARY 11.—*Gold Production.*—The crushing of the ore; the stamp mill—The extraction of gold by amalgamation; smelting; chlorination and cyanidation—Reforms in consequence of the tube mill and the filter press—Tube mill *versus* pan—Proposed abolition of the stamp battery—The depth of ores; surface and secondary enrichment—Mining costs and gold mining organization.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

PROF. HERBERT JACKSON, F.I.C., F.C.S, "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. John Walter Gregory, "Gold Mining and Gold Production." (Lecture II.)

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Inaugural Address by the President, Mr. Richard St. George Moore.

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Messrs. P. Schidrowitz and F. Kaye, "The Chemical Composition of some Motor Tyre Rubbers." 2. "The Composition of some New Crude Rubbers."

British Architects, 9, Conduit-street, W., 8 p.m. President's Address to Students.

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. Martin L. Rouse, "The Bible Pedigree of the Nations."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Harry de Windt, "Through Savage Europe."

TUESDAY, FEB. 5...Royal Institution, Albemarle-street, W., 3 p.m. Prof. A. C. Seward, "Survivals from the Past in the Plant World." (Lecture II.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

Designers, in the Galleries of the Royal Society of British Artists, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. J. D. Craw, "Purposes in Colour Decoration."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Colonel R. E. B. Crompton, "Modern Motor-vehicles."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, FEB. 6...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Thomas Emley Young, "The Principles and Practice of Insurance, and their Modern Developments."

Geographical, Burlington-house, W., 8 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Col. W. G. Macpherson, "The Role of the Red Cross Societies in Peace and War."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. C. E. Keyser, "A Day's Excursion among the Churches of South-east Norfolk."

Obstetrical, 20, Hanover-square, W., 8 p.m. Annual Meeting.

African, Criterion Restaurant, Piccadilly, W., 9 p.m. Mr. Leslie Probyn, "Sierra Leone."

THURSDAY, FEB. 7...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Otto Stapf, "New Plants from Malaya." 2. Mr. F. Chapman, "Tertiary Foraminifera of Victoria.—The Balcombian Deposits of Port Phillip."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. H. J. S. Sand, "The Rapid Electroanalytical Deposition and Separation of Metals. Part I.—The Metals of the Silver and Copper Groups and Zinc." 2. Messrs. G. Barger and F. H. Carr, "The Alkaloids of Ergot." 3. Messrs. G. T. Morgan and F. M. G. Micklethwait, "Influence of Substitution on the Formation of Diazo Amines and Amino Azo-compounds. Part VI.—The Partially Methylated 4:6-diamino-m-xylenes." 4. Mr. F. Tutin, (*a*) "The Reduction of Hydroxylaminodihydroumbelluloneoxime"; (*b*) "The Constitution of Umbellulone. Part II.—The Reduction of Umbellulonic Acid." 5. Messrs. R. H. Pickard and W. Oswald, "Studies on Optically Active Carbimides. Part V.—The Aryl Esters and the Amides of 1-menthylcarbamic Acid." 6. Messrs. A. G. Perkin and W. P. Bloxam, "Some Constituents of Natural Indigo." Part I. 7. Mr. A. G. Perkin, "The Occurrence of Isatin in some samples of Java Indigo." 8. Messrs. W. N. Hartley and E. P. Hedley, (*a*) "The Absorption Spectra of Benzoic Acid; the Benzoates and Benzamide." (*b*) "The Absorption Spectra of Phthalic Isophthalic and Terephthalic Acids. Phthalic Anhydride and Phthalimide." 9. Messrs. H. Henstock and C. H. G. Sprankling, "$\alpha\alpha\gamma$ Trimethyl-and $\alpha\alpha\gamma\gamma$ Tetramethyl-tricarballylic Acids, and $\alpha\Delta$ dimethylbutane $\alpha\beta\Delta$ tricarboxylic acid." 10. Professor J. F. Thorpe, "A Reaction of Certain Colouring Matters of the Oxazine Series."

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Prof. W. W. F. Pullen, "Some Forms of Dynamometers."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Clifford C. Paterson, Discussion on Paper, "Investigation on Light Standards and the Present Condition of the High Voltage Glow Lamp." 2. Messrs. H. F. Haworth, T. H. Matthewman, and D. H. Ogley, "Comparative Life Tests on Carbon, Nernst, and Tantalum Incandescent Lamps using Alternating Currents."

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m.

London Institution, Finsbury-circus, E.C., 6 p.m., Dr. C. W. Pearce, "The Lives and Music of Henry Smart and Edward J. Hopkins."

Royal Institution, Albemarle-street, W., 3 p.m. Major Percy Macmahon, "Standards of Weights and Measures." (Lecture II.)

FRIDAY, FEB. 8...Royal Institution, Albemarle-street, W., 9 p.m. Prof. J. Gollancz, "Old English Poetry."

Civil Engineers, 25, Great George-street, S.W. 8 p.m. (Students' Meeting.) Mr. Claude Pain, "The Reconstruction of a Swing-bridge on the Southwold Railway."

Astronomical, Burlington-house, W., 8 p.m.

Geologists' Association, University College, W.C., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, 8 p.m. Annual Meeting.

SATURDAY, FEB. 9...Royal Institution, Albemarle-street, W., 3 p.m. Rev. W. Barry, "Papal Deposing Power." (Lecture II.)

PANAMA CANAL.—Monsieur Bunau Varilla asks that following corrections may be made in his paper and discussion, printed in the last number of the *Journal*:—Page 250, col. 1, ll. 48-49, *for* "one quarter soft rock, one quarter hard rock, and one half earth," *read* "one half soft rock, one quarter hard rock, and one quarter earth." Page 274, col. 2, the prices of one shilling and ninepence a yard given by Mr. Quellenec and Mr. Hunter respectively, apply to the operation of making the excavations dredgable by the Lobnitz process, and the cost of dredging must be added to obtain the total cost of excavation.

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No. 2,829. VOL. LV.

FRIDAY, FEBRUARY 8, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 11, 8 p.m. (Cantor Lecture.) PROFESSOR JOHN WALTER GREGORY, D.SC., F.R.S., "Gold Mining and Gold Production." (Lecture III.)

WEDNESDAY, FEBRUARY 13, 8 p.m. (Ordinary Meeting.) LORD MONTAGU OF BEAULIEU, "Motor Omnibuses."

THURSDAY, FEBRUARY 14, 4.30 p.m. (Indian Section.) SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., "The Practical Side of Famine in India."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Professor JOHN WALTER GREGORY, D.Sc., F.R.S., delivered the second lecture of his course on "Gold Mining and Gold Production" on Monday evening, February 4th, the particular subject being Lode Mining. Before treating of the chief types of gold bearing lodes the lecturer drew attention to the confusion caused by the use of the term "reef" for both ore and "country" rock. He then dealt with the importance of ore genesis in reference to mine development; the chief gold fields of the world and their structures, concluding with an account of the Rand and its banket.

The lectures will be published in the *Journal* during the summer recess.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready and can be obtained by members on application to the Secretary.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, January 24; SIR WILLIAM LEE-WARNER, K.C.S.I., Vice-President of the Society, in the chair.

In the absence of the author, the paper was read by H. M. BIRDWOOD, C.S.I., M.A., LL.D.

THE BHILS OF WESTERN INDIA.

By Captain E. Barnes
(Indian Army).

The Bhils are an animistic race, inhabiting the wild and hilly tracts of Western India, which stretch from Udaipur in Rajputana southwards across the Vindhya and Satpura mountains to the plains of Nimar and Khandesh, and from the borders of Gujerat eastwards to the rich Malwa plateau. According to the Census of 1901, their number may be put at 1,200,000*, divided principally among the British districts of Khandesh and the Panch Mahals in the Bombay Presidency; the Native States of Indore, Gwalior, Dhar, Jhabua, Rutlam, Sailana, Ali Rajpur, Barwani, and Jobat, in the Central Indian Agency.

Origin of the Race.

As regards the origin of the race, modern writers hold them to be, equally with other animistic tribes of India, a relic of the aboriginal or Dravidian population; they themselves claim descent from Mahadeo, or one of his numerous incarnations, and the Vedic tradition claims for them a purely Aryan origin. One of their own traditions relates how Mahadeo, having come down to earth, lost his way in the dense forests, and while wandering therein met a maiden of great beauty, of whom he became enamoured and by whom he had a large family. One of the sons (the ancestor of the Bhils), distinguished from his early youth by his ugliness, the dark colour of his skin, and the evil habits of his life, crowned his career in his father's house by killing the sacred cow. For this offence he was exiled from the fertile countries of the plains to dwell for ever in the hilly forest tracks —a true Ishmaelite—to live by the sword in perpetual enmity with his more fortunate brethren.

The Vedic tradition, which I may briefly quote from the Vishnu-Purana,† after detailing the ancestry of Vena, who, it is stated, inherited the evil propensities of his maternal grandfather, observes that when "he was inaugurated, by the Rishis, monarch of the earth, he caused it to be everywhere proclaimed that no worship should be performed, no oblation offered, no gifts bestowed upon the Brahmins. "I, the king," he said, "am the lord of sacrifice. Who but I am entitled to the oblations?" In vain the Rishis remonstrated. The godless Vena would have none of it, and the pious Munis decided that they must kill him, as he was not fit to reign over the earth. "So they fell upon the king and beat him with blades of holy grass, consecrated by prayer, and slew him who had first been destroyed by his impiety towards God." Vena being dead without offspring, the difficulty arose that there was no one to rule and maintain order in the land, and the Puran goes on to detail how the sages consulted together and rubbed the thigh of the dead king to produce a son. "From the thigh thus rubbed came forth a being of the complexion of a charred stake, with flattened features, and of dwarfish stature." "What am I to do?" cried he eagerly to the Munis. "Sit down" (*nishida*) said they, and thence his name *Nishada*. His descendants, the inhabitants of the Vindhya mountains, Great Muni, are still called Nishadas, and are characterised by the external tokens of depravity.

This tradition is also repeated in the Bhagavata-Purana (see Burnouf's translation IV. 14,43, 46), while the Padma Purana (Bhumi Khanda) has a similar description, adding to the dwarfish stature and black complexion, a wide mouth, large ears, and a protuberant belly. It also particularises the posterity as Nishadas, Kiratas, Bhillas, and other barbarians living in woods and on mountains.

Past and Present.

So much for unalloyed tradition. Tod remarks that we can trace the Bhils as powerful communities as far back as the "Mahabharata," when they were lords of all the countries through which they are now sparsely scattered and much else besides, and extended northwards to the sandy plains of Jodhpur. The name Bhil is immortalised in the "Mahabharata," where it is stated that a follower of the Bhil chief of Maheshwara on the Narbada (the modern Mahesar) slew with an arrow the demigod Krishna on his retreat towards Gujerat after the celebrated battle of the Kurus and the Pandus.* Dunji, who ruled in Malwa in ancient times, is deemed by most accounts to have been a Bhil, and his descendants maintained the dynasty for nearly 400 years until ousted and conquered by the great Rajput tribe of Puar.

* *Cf.* Census of India, 1901, vol. i A., p. 318, Table XIII.

† *Cf.* Vishnu-Purana, Wilson's Book I, chap. 13, Translation, Vol. I., pp. 179 *et seq.*

* Malcolm's "History of Central India."

Authentic records of the Udaipur and Jodhpur families show that large tracts of these States were conquered from the Bhils, and the same is the case with the Jhabua State in Central India, which as late as A.D. 1550 was a small Bhil kingdom, and then passed to the ancestors of the present Rajput chief under a grant from Akbar, on the conquest of the Bhil ruler by the Rajput leader.

From the above it seems evident that in remote times, prior to the establishment of the great Rajput kingdoms of Western India, the Bhils were the ruling race; that with the advance of Aryan civilisation they were gradually driven more and more into the hilly forest tracts; and that this process of expulsion, absorption and subjugation continued with more or less vigour until the establishment of British supremacy in the early years of the nineteenth century, when, so to speak, the fluidity of rights and tenures on the Indian Continent was arrested, and each one was confirmed in what he had. By that time, however, the Bhils had long lost all independent power. They were to be found only in the wild districts above enumerated, nominally subordinate to the native chiefs. Agriculture was practically unknown among them, and they lived almost entirely on the products of the chase and of the jungle, supplemented by the profits of loot and blackmail, which they levied whenever possible on all who came within their reach. Whatever their true ethnological origin may be, and on this point there seems little doubt that the basis of their race is non-Aryan, they have largely lost the physical characteristics so minutely described in the Vedas. True it is that in the more distant districts, individuals and even whole families of this unattractive type may still be found, but the mass of the race are far from unattractive. They are small but well proportioned, both men and women —lithe and active, and their features not irregular. The various types which are met with undoubtedly prove a large admixture of Aryan (principally Rajput) blood, but to whatever degree the physical type may have altered, their mental outlook is but little changed, and to this day the Bhils have remained a class apart—despised, though at the same time feared, by the Hindu population, and themselves intensely suspicious of civilisation in any form, or of any system or administration which might tend to restrict their absolute freedom of movement.

In the wilder tracts, where the native administration has changed but little with the course of centuries, their country is only on rare occasions visited by the native officials, and in some places the only meetings that take place between the authorities and the subjects require special protection in the form of an oath (*bachan*) for the safe conduct of the parties.

In parts where, for various reasons, the administration has been stronger during the last forty years, the Bhils are losing some of their independence of nature, and gradually becoming more amenable and more useful members of society—more peaceful and settled in their relations with the authorities. Even in these parts, however, they need very careful handling. They still have that primal characteristic of an uncivilised race—an extraordinary suspicion of anything which tends to change their traditional form of life. An ill-considered or premature reform; a greater strictness or even a change in the system of revenue collection; an epidemic or any misfortune in their house or village which appears as a visitation of the evil spirits—any of these things is sufficient to cause wholesale emigration, either to the jungles, when robbery and murder will immediately increase, or to some other jurisdiction where they may hope to find more congenial or auspicious surroundings.

Their villages are typical of themselves. Instead of the agglomeration of mud huts, each adjoining the other and crowded as closely as possible into a given space, which may be taken as a type of an ordinary Indian village, the Bhil's hut stands alone, completely enclosed with a high-thorn fence. For choice it is perched on a hillock, and is surrounded by the fields which the owner cultivates. The nearest neighbour is probably 200 or 300 yards away, similarly detached and isolated, with bits of jungle intervening.

Bearing on this point and on the great desire of the Bhils to be left alone, I remember on one occasion in a very wild part of the country coming across a carefully-prepared threshing floor in the middle of the forest. It was in December, and a Bhil with his family was busy threshing the autumn crop. There was no hut or dwelling-place of any kind in sight, so I asked the man where he lived and why he did his threshing in the jungle. "Oh!" he said, "my home is over there," pointing through the forest, "and we make the threshing floor here because here we are not troubled." I subsequently found the house in a clearing about three-quarters of a mile

away. There is undoubtedly a method in their madness, and they have taken the measure of the average native subordinate, who, coming to a hut of that kind on State business and finding it apparently deserted, will probably be content to report that the owner has emigrated.

Headmen.

But though the control exercised over individuals by the various durbars is often very slight, the Bhils have a strict sense of obedience to their own headmen (tarvis, patels, or zamindars as they are variously called) and it is in consultation with these, and through these, that the orders of the durbar are framed and carried out. In the best administered tracts these headmen are persons of much importance and prior to the recent famines of considerable wealth. In return for free grants of land and cash payments which they enjoy, they assist materially in collecting the yearly revenue, which is calculated on the number of ploughs (*i.e.*, pairs of bullocks) that a man possesses; they advise as to whether and if so to what extent any remissions of revenue should be granted; it is their duty to report crime and to track and arrest the criminal, and when necessary individuals or whole villages are called in through their agency to meet the officials. They also in many cases form courts of arbitration (*panchayats*) for the settlement of disputes arising among their clansmen, the verdict of such tribunals being accepted im-implicitly by the parties.

An influential headman can easily collect in two hours an armed following of 200 to 300 men. It will, therefore, be readily understood that, in the Native States, where the central authority is usually but weakly felt, these people exercise much weight. They are indeed the intermediaries between the subject and the ruler, and the fact that their rights are hereditary naturally tends to increase their dignity and influence.

Moral Qualities.

As to the moral qualities of the race, great simplicity and a certain natural fearlessness of consequences are qualities which immediately induce sympathy in a European mind, but which, at the same time, cause them much trouble in their dealings with their more astute fellow Indians. Again, up to a certain point, and especially in the wilder tracts, where they have not been contaminated by what we may call the "criminal classes," they are extraordinarily truthful. On many occasions it has been my duty to try Bhils for offences of every degree of seriousness, from murder or *dakaiti*, through all the gamut of the Penal Code, down to ordinary assaults or thefts. In the great majority of cases arrest was followed by confession, not of a half-hearted kind, but accompanied by a full *exposé* of reasons for the crime. So much is one impressed by this extraordinary simplicity that, except in cases where habitual criminals are concerned, the denial of a charge by a Bhil would form the strongest evidence he could produce in proof of his innocence.

The family ties in ordinary times are strong, and though chastity in an unmarried girl is not, perhaps, so common as it should be, adultery on the part of a married woman is a serious offence which, under the best of circumstances, entails a heavy fine on the co-respondent, and if aggravated, as sometimes happens, by insults offered to the aggrieved husband, will almost invariably entail the death of the erring wife or the co-respondent, or both, at the husband's hands.

Cruelty or premeditation is not, as a rule, common, except in cases of this kind or where superstition has been at work. A typical case of the effect of the latter may perhaps be of interest. A man had lost his wife and two or three children through disease of some kind—probably from some form of vegetable poison in the wild roots which, especially during hard times, constitute a large portion of the Bhil's diet. In the neighbouring village, there lived an old aunt, who, for no reason, apparently, except that she was old and, therefore, perhaps, very ugly, became a subject of suspicion to the bereaved parent. Possibly an absence of active sympathy, not uncommon in old people, may have enhanced the suspicion, but in any case the man was satisfied that his aged relative had the evil eye and had thereby caused his misfortune. Taking two companions with him to guard the exits from the hut, he proceeded there in the dead of night and found the old lady asleep. Without further ado, and in perfectly cold blood, he battered her to death as she lay on her bed, while her husband was knocked down and met a similar fate at the hands of the men outside. Having taken what he regarded as his just revenge, he returned to his own village and gave himself up to the headman, stating in full detail all that had occurred.

Other Characteristics.

The Bhils are naturally of a gay disposition. They have a keen sense of humour, and can laugh better than most Indians. On all possible occasions they are ready to dance and sing, and indeed nothing is more characteristic of the country than to see a crowd of 200 or 300 Bhil men and women enjoying themselves in this way. Broken up into groups, they perform with great correctness and often with much grace various forms of dance to the accompaniment of primitive instruments of the drum and cymbal type, singing the while either traditional songs of famous Bhils or others of a more or less religious kind suitable to the occasion. At first the men and women will dance separately, but as the evening wears on, and the wine, which is an invariable accessory, begins to take effect, the men and women dance together until the excitement reaches a somewhat dangerous point, when the women withdraw from the circle and use their influence to calm their more excited male relatives.

Among the Bhils the women are generally more intelligent, and have a far greater fund of common sense, than the men. They exercise in many cases a predominating influence in their homes, and have practically the entire management of the house. It is they who urge moderation on their lords and who intervene, often successfully. in quarrels arising under the influence of liquor. Though drinking is the great curse of their country, and a drunken Bhil on market days is the commonest sight, the women are sober and very seldom indulge to excess.

To all manual labour the Bhils have an inherited dislike, and their agriculture is consequently of the most primitive kind. In former times the system known as *walri* was very largely practised. In its essential features this consists of burning a patch of forest, and sowing the crop with little or no tillage in the ashes. Sometimes such a clearing would be used for three years in succession, but often the clan moves every year to a fresh field. The wanton destruction thus wrought is, of course, enormous, as, in addition to the timber trees deliberately burnt to clear the soil, the fire not infrequently runs wild through scores of square miles of forest. In the wilder tracts this system is still to be seen in practice, but, with the spread of a knowledge of forestry, the Durbars are endeavouring to stop it completely, and to induce the Bhil to settle as permanently as may be on the lands he cultivates. Even when this stage has been reached, however, his cultivation is generally limited to a single ploughing of the field after the rains have fallen in June, sowing the seed, one weeding, and the reaping and harvesting in October and November. With the produce so obtained the State demand is paid, new clothes are bought, and the remainder is stored for the food supply of the year.

The costume of the men is of the most scanty kind, and is generally limited to a small piece of cotton cloth passing between the fork and covering the loins and fastened round the waist to a thick thread; another small piece of the same material is bound round the head, forming a scanty turban, but leaving the crown quite bare. In addition a light cotton sheet is thrown over the shoulders, and this is used as a covering at night. One must not, however, forget the bow and arrow, which to this day the Bhil invariably takes with him in the forest or when moving from place to place. They are ordinarily barefooted, but sometimes wear sandals consisting of a leather sole fastened to the foot with string or bark. In spite of their scanty attire, they are vain of their personal appearance, and on festivals and such occasions bestow much care on the oiling and dressing of the hair, which is worn long and carefully combed; the wooden native comb and a small mirror being stuck jauntily on the side of the head between the folds of the *pagri* and the hair.

The women are usually well dressed, the whole body from the knees upwards being covered with the usual body cloth and head covering, and a short coatee over the breasts. Both the sexes are fond of jewellery and when times are good heavy silver ornaments are often to be seen. In certain parts of the country the women also wear heavy brass anklets about 1½ to 2 inches broad, one above the other, so as to completely cover the leg from the ankle to the knee. When dancing both sexes wear anklets with bells to mark the rhythm of the step.

Aversion to Manual Labour.

But to revert to their objection to manual labour. Rather than work as labourers or coolies they will go without food or live on the coarsest substances such as roots, leaves and other wild produce of the forests, and when not otherwise engaged they will roam over the forests in search of edible or other economic products for home consumption or for barter or sale. For instance, the Mohwa tree (*Bassia*

latifolia), which is fortunately so common throughout large areas of the Bhil country, is a perfect mine of wealth. Its flowers and seed are both most valuable. The flowers (*corollas*) provide a very large proportion of the Bhil's food supply. They are eaten fresh, dried, and also cooked with parched grain. In the spring when the buds appear whole families temporarily migrate to the jungles for the "Mohwa harvest." The ground round the tree is carefully cleared, and as the flowers fall they are collected and stored. When dried they are sold in the bazaar for the liquor trade, and it is from these that practically the whole of the native liquor consumed in Central and Western India is distilled. In times of scarcity the monetary value of the mohwa flower rises with the intensity of the distress, and it often becomes of vital importance. In former years there was a large export of the flowers to France, where they were utilised for the manufacture of brandy, but the importation has, I believe, now been prohibited.

The mohwa seed contains a valuable oil, which is used locally for cooking, for burning, and medicinally for application in cases of skin disease. A large quantity is exported annually to France, and doubtless contributes considerably to the world's supply of olive oil; it is ostensibly intended for the manufacture of soap. Further, a white milky juice is obtained from cracks in the bark, and the bark itself is often utilised for dyeing purposes, while the flowers, in the form of a decoction, provide a medicine largely used and much appreciated as a stimulant, an astringent, and even as a cough mixture!

With all these many properties it cannot be a matter for surprise that the mohwa tree is regarded as sacred by the Bhils, and that it is almost the only tree of the forest that they will not either cut or destroy. It is jealously guarded as the personal property of the holder of the land in its neighbourhood, and it is only in the depths of the forests that the first comer has the right to sit down under the tree and collect the crop.

Second to the mohwa, comes the mango (*Mangifera indica*), which is also a common forest tree in these parts. Then the chironji (*Buchanania latifolia*), the nuts of which are much prized, and which are the common substitute for almonds in native confectionery; this crop is carefully collected by the Bhils and used as food, but, as in the case of the mango crop, it is more generally sold in the markets. The temru (*Diospyros Melanoxylon*) with its fruit about the size of a plum, and the tinis (*Ougenia dalbergioides*), the leaves of which are in very large demand in the Bombay Presidency as a covering for native cigars and cigarettes, are specimens of the many trees which add to a Bhil's income and afford him congenial occupation throughout the spring and summer months.

The rooted objection of the Bhil to manual labour was markedly and disastrously shown in the great famine of 1899-1900. For the first time within living memory these wild areas felt the full force of an almost complete failure of the south-west monsoon, with the result that not only were the cereal crops entirely destroyed, but, owing to the lack of moisture, the wild roots and bulbs and even the grass failed to germinate. In spite of this, it was a matter of the greatest difficulty to induce the Bhils to take advantage of relief works opened for them. They preferred to sell all their ornaments and jewellery, so that the country bazaars were rapidly flooded with articles of this kind, and silver ornaments became a drug in the market. The household utensils then suffered the same fate, and when everything was exhausted, the Bhil either took to the war path and looted far and near wherever opportunity offered, or, if wanting in energy, wandered off into the forests, probably to die.

When one thinks that the price of the staple food—grain—in their country varies in normal seasons from 60 to 80 lbs. to the rupee, and that during the recent famine years the price averaged between 16 to 25 lbs., or, in other words, that a penny loaf cost 4d., or for some months 5d., there is little cause for wonder that the inherited marauding instinct of the race should make itself felt, and that peace and security of property or person should disappear until a return of normal seasons removes the necessity for crime.

These conditions, as I have observed, were specially marked in 1899-1900. In the following years, when distress continued in certain parts, and when relief operations were again necessary, it was found that there had been a great change. Many had learnt their lesson, and in 1902 in one State where in 1899 the people had especially suffered, there were thousands of adult Bhils, men and women, working well, and regularly on relief works on a minimum wage of 20 to 24 ozs. of grain a day.

But the place where the Bhil is at home,

and where the characteristics of his race may be seen to the best advantage, is in the forests. It may be said that his primary instinct is to hunt. Invariably carrying his bow and arrows, he will cover great distances, walking or running, and nothing in the form of the game is too lowly for him. An unannounced visit in the neighbourhood of a village will often reveal the men and boys hunting hare, pigs, foxes and even cats, and they have been known to run down sambhur, blue-bull (*nilghai*) and bear. Their senses of sight and hearing are highly developed, and they are splendid trackers, either of man or beast. While in the forests they fear nothing; in towns and outside their own country they become timid and uncertain of themselves, and will allow themselves to be bullied by the smallest urchin of the place.

Tribal Divisions.

The race is divided into a number of tribes, each tribe being again divided into an almost endless number of exogamous septs or clans. In all, I believe, there are 114 different divisions of this kind. The principal tribes in Central India and Rajputana are Rathia, Pouria, Patlia, Tarvi, Naik, Damar, Nanama, Daima, Akaria, Khararia, &c. The Rathia tribe is divided into ten exogamous clans—Bondar, Solia, Sastia, Jamra, Khaitia, Awaya, Bamnia, Nargaon, Chouhania, Kiraria, and Chougria. The Rathias are supposed to have been the original inhabitants of the Rath country, which now forms the greater part of the Ali Rajpur State in Central India and includes Jobat and part of Chota Udaipur State in the Panch Mahal district and the thakurates of Kathiwara and Ratanmall.

The Naik tribe has eight exogamous divisions — Mowla (lion), Solia (bird), Pawar (pigeon), Chohan, Beria, Nikam, Bagul, and Nairia. They claim descent from Khande Rao, one of the many avatars of the god Vishnu, and are generally supposed to have had their original abode in Khandesh. They are, perhaps, the most warlike and most formidable of all the Bhil tribes, and on the least provocation are ready to return to their old habits of plunder. They are to be found principally in the Western Satpuras and on the banks of the Narbada, in the wild country where that river divides the Satpuras and the Vindhyas, and in these parts they still receive payments from the States in consideration of good behaviour and for keeping the passes and fords open. In addition, in many places they receive a toll of 1—2 annas from travellers passing through their settlements. Several of the Naik clans are totemistic and highly reverence the totem from which they are descended. This also applies to other clans. Thus they will not kill, eat, or cut the bird or animal to which they belong. They swear by it and are usually tattooed with it on the chest and arms. The usual fine for a man who insults his totem is Rs. 5.

The Tarvi tribe is sub-divided into 17 clans as follows:—Mohinia, Daitya, Dwarkia, Bhamnia, Daoria, Varkla, Maoria, Mari, Bondria, Massania, Vasbia, Ajnaria, Vasnia, Berja, Singaria, Pachao, and Kikria.

The monkey is to them very sacred and is regarded by many as their ancestor. They consider themselves as aboriginal to the forests of the Satpura, Vindhya, and Aravali mountains. Their principal deity is the snake god (*Bhilat deo*). The tribe is very numerous and indeed, as will have been observed above, their name has, in many parts of the country, become synonymous with that of headman: in other parts the tarvi of the village is more the village watchman, whose special duty it is to act as guide to travellers or to carry on the tracking of criminals or stolen cattle which may be traced up to the limits of the village. A large and important section of the community are the Bhilalas. These, as their name implies, are half-bred Bhils, and are the descendants of Rajput men and Bhil women. They consider themselves as superior to the Bhils to the extent that they will not eat with them, and, indeed, are generally better favoured by nature, both physically and mentally. The Bhil, however, does not regard them with any special respect, and if he thinks of the matter at all, the tendency is to despise them slightly as half-castes.

Religion.

The religion of the Bhil is, as I have said, animistic, that is, "he has a tendency to worship with a view to propitiate anything he does not understand, such as the manifestation of great power or an object of unusual shape or form."* This definition, however, hardly covers all the objects of his veneration. The respect and reverence which Bhils pay to valuable forest trees such as the mohwa, the teak (*Tectona grandis*), the pipal (*Ficus religiosa*), the banyan (*Ficus bengalensis*), the sal (*Shorea robusta*), and the anjan

* *Cf.* Bombay Census Report, 1901.

(*Hardwickia binata*), all of which largely assist them in their struggle for existence, show that ideas of utility count for much in the matter. Purely animistic worship, however, such as that devoted to the earth, the sun, the great rivers, some special mountain peaks, a rock or stone of curious shape. or even a solitary mound rising from the plain is general; also the worship of animals, but in this case the animal venerated varies, as already remarked, with the totem of the tribe. Then, too, although a Brahmin is nothing to a Bhil, the Hindu pantheon is not altogether neglected, and the terrible Kali, Ganesh the elephant, and Hanuman, the monkey god, are common objects of reverence.

The following are the names of some of the principal gods and goddesses worshipped by the Bhils in the Jhabua State in Central India :—1. Hatipowa,—as the guardian of village cul-cultivation at the Hindu festivals, Diwali and Dassera in the autumn. 2. Waghacha Kumvar, against ravages of wild beasts. 3. Khorial Mata, for protection of cattle. 4. Halk Mata, for success in plundering expeditions (with the spread of the *Pax Britannica*, this worship must necessarily have diminished, though she must have had many devotees during the recent famine). 5. Devi Kanail, for good harvest. 6. Behia Baji, for rain. 7. Ghora Raja, against attacks and plunderers. 8. Chamunda Mata, goddess of harvest; first fruits are offered to her. 9. Bhubhai Mata, in times of epidemic disease. 10. Sitla or Sita Mata, goddess of small-pox.

The names of most of these probably vary in different parts of the country, as in each tribe the origin of the deities varies; but Hatipowa, the guardian of cultivation, Khoria Mata, the protectress of cattle, and Chamunda Mata, the goddess of harvest, are commonly found, while Sita Mata is probably the recipient of more veneration than any other object in the Bhil country. Outside of almost every village, if possible near the boundary, under the shade of a banyan tree, against which leans some queer-shaped stone smeared with vermilion or black lead, will be found a heap of broken pottery, consisting of earthen water vessels, animals in the shape of a horse, or little human figures, hollowed out to hold the offerings of grain. Such is the shrine of the dreaded Sita Mata.

Temples in our acceptation of the word do not exist. The images or idols, if they exist at all, are usually pieces of shapeless stone, smeared with an oily mixture of vermilion or black colour, placed in a grove of trees; or even some great tree will suffice to represent the deity, and the only outward sign of sanctity may be strips of cotton cloth tied to its branches. The worship itself usually consists of a feast at which fowls or he-goats are sacrificed, to the accompaniment of songs and music performed by rawals or dholis, the bards of the race. The idol receives a fresh smearing of oily colour and a small portion of the sacrificial meat with a little grain is burnt before it. The remainder of the flesh is then divided and the feast continues with the consumption of much liquor, the bards receiving their share. On greater occasions, as for instance at the worship of Hatipowa at Dassera, a bullock is sacrificed, doubtless in imitation of the Hindu custom. Again, the first ceremony of a marriage, when the negotiations are proceeding between the two families is a libation offered to the great goddess Earth, to ensure her blessing on the marriage that it may be fruitful and fortunate. In this case one rupee is placed on the ground by the bridegroom's representative between the contracting parties, and on the rupee a little wine is poured. When the negotiations are concluded the tarvi of the village has the right to this rupee.

The most auspicious days for worship are, it appears, Sunday and Tuesday, while Tuesday and Thursday are auspicious for the commencement of agricultural operations after the rain has fallen.

Finally, the Bhils believe that for at least three days after death the spirits of the departed are free to wander on the earth, and that, unless appeased with suitable worship, they may seriously affect for evil their relations or acquaintances. During this period they are supposed to dwell in trees, especially in those of the valuable species above-mentioned, and thus also we find another cause for the veneration with which these products of nature are regarded.

SOCIAL CUSTOMS.

Throughout the race marriage is deferred until an adult age, usually 18 for boys, and 15 or 16 for girls. Unchastity in a girl is generally tolerated on the understanding that if she becomes *enceinte* it is condoned by marriage. Polygamy is permitted, but as the wife brings no dowry, it is largely a question of means. The re-marriage of widows is also allowed in most tribes, and she may and does often marry her deceased husband's brother.

Adultery in a married woman entails divorce, if nothing worse, and the divorced woman may marry again under a special form known as *natra*, for the consummation of which no special ceremonies are needed and the woman does not enjoy the full status of a lawful wife. The laws of marriage are endogamous within the tribe, but strictly exogamous as regards the septs or clans. Thus a Naik must marry a Naik woman, but he must not marry into the sept to which either his father or his mother belonged, nor anyone within two degrees of relationship on either side. In some cases, amongst the Tarvi tribe, for instance, marriage is determined by a regular courtship, and in others, where the bridegroom is very poor, he follows the example of the patriarch Jacob and goes and works in the bride's house for seven years. The couple, however, live together as man and wife from the commencement; no money is paid on either side, and the son-in-law is accepted more or less literally as a son in his new home. The general rule, however, is that the marriage is arranged by the parents of the young couple, after confidential inquiries have been made on both sides. Money is paid by the bridegroom's family for the bride. The ordinary amount in former times in the Jhabua State, for instance, was Rs. 90 of the Salim Shahi coinage, in lieu of which British Rs. 45 are now accepted. Out of this money, clothes and jewellery for the bride are bought to the extent of about half the sum, and the remainder is divided amongst the bride's family. It will be observed that this system is directly opposed to all Hindu law and custom, under which, according to the Shastras, all expenditure should, if possible, be on the side of the bride's family, and a dowry should be given, and where the principle that a girl can (so to speak) be bought by the bridegroom's family is regarded as highly improper. There would seem to be little doubt that it is a relic of pre-Aryan civilisation. In his "History of European Morals," Lecky deals fully with this subject. I need only remark here that the immediate practical result is that amongst the Bhils the birth of a girl is in no way deplored, and indeed is a matter for congratulation; the exact converse of Hindu society, where the birth of a girl is regarded as a nuisance, if not as a calamity, and in former times was not uncommonly the cause of much infanticide.

The ceremonies now to be detailed are those in force amongst the Bhils of Jhabua, a State situated practically in the centre of the Bhil country. As with their worship, their customs also probably vary in detail in different tribes, but the general system may, I think, be accepted as common to the race.

If the confidential enquiries made by the bridegroom's family are satisfactory, a formal "embassy" is sent to the bride's family to settle the betrothal or *sagai*. This embassy consists of three or four men, who come fully armed with their bows and arrows, &c., and sit down outside the bride's house. Before proceeding to business, the libation to the earth, which I have mentioned above, is made. Each party has previously brought with it its own wine, and when the libation has been performed the tarvi of the village gives permission for the wine to be mixed and appoints two men, one to mix it and the other to distribute it; the former receives eight annas, and the latter four annas from the bridegroom's party.

When the details of the betrothal, *i.e.*, the sum to be paid by the bridegroom (known as *dehaj*) have been settled, the father presents the bride with some jewellery usually a nose-ring and a necklet, and the marriage is regarded as fixed when the *dehaj* has been paid. The actual days for the performance of the ceremony are decided on after consulting the old men of the clan. The stars are specially considered, but there is no need whatever for astrologers or Brahmins, the latter being never employed by the Bhils.

Before the bridegroom's procession starts from his house or village, a certain period, from three to nine days, according to the wealth of the family, is passed in feasting and singing, &c. The period so fixed is always an uneven number of days on which only the ceremonies are performed. No work is done, and as many days as are spent in this way, for each day a piece of haldi (*Curcuma longa*) root (turmeric) is tied by a tri-coloured thread to an arrow shaft and sent to the bride's house, where similar ceremonies for a similar number of days must be performed. During this period the special ceremony of *notra* is performed at the bridegroom's house. Invitations to attend it are issued to relatives and clansmen by messengers, usually *dholis*, who leave a handful of rice on the threshold of the door of each invited guest's house. The bridegroom receives his guests seated in a pavilion (*mandwa*) with a plate in front of him, in which his relatives place their presents (*notra*) varying from one to five rupees, while his clansmen give

similar presents of from two annas to one rupee.

All preliminaries being duly performed the procession starts for the bride's village, and on reaching the boundary word is sent to the bride's father that he should come out with his relatives to take the usual *laq*, *i.e.*, certain payments over and above the *dehaj* or betrothal money, which now fall due. These payments, which are as follows, are then made in the presence of the village tarvi :—

Due to the Durbar	R. 1·4·0	
The tarvi of bride's village ..	R. 12	Salim Shahi
Bride's mother	R. 12	,,
,, maternal uncle	R. 12	,,
,, paternal uncle	R. 12	,,
,, brothers	R. 12	,,
,, sister	R. 2	,,
,, paternal aunt	R. 2	,,
,, village dholis	R. 12	,,
The tarvis of neighbouring hamlets	R.	1 worth of wine
Eunuchs*		8 annas
State Purohit (priest)		8 ,,

It will be readily surmised that in regard to all these payments cash is not often available, so the matter has to be settled by the barter of buffaloes, bullocks, goats, &c., or even mango or mohwa trees may change hands in this way. After the payment of the *laq*, a feast is given by the bride's father. The bridegroom then goes to the bride's house, and touches the *toran*, or garland, which decorates the entrance, with his sword, paying a fee of 4 annas to the village *kotwal*, or policeman. He then advances towards the pavilion (*mandwa*) of the bride, but is stopped by the bride's brother, who places his foot on the bridegroom's foot; on payment of 8 annas he is allowed to proceed. He next seats himself in the pavilion and the bride is brought out of the house. She is clothed in white, the border of the garment being stained yellow with *haldi*. She wears a crown of tinsel (*mor*) on her head and her hair is allowed to hang down her back. The bridegroom is also simply dressed in white. The *sari* (head-covering) of the bride is now tied to the bridegroom's pagri, and the two sit down facing the East, the bride on the left. A small bundle, consisting of a little rice dyed with *haldi*, one pice (¼ anna), and a betel nut, the whole wrapped in a mango leaf, is then given to the bride by her sister-in-law or aunt, and she is told to hold it tightly. A cloth is placed over both their heads and the groom is told to take the mango leaf out of the bride's hands, using one hand only. This is duly done. The *phira-phirni* ceremony is then performed, which consists in the couple, tied together as they are, circling round a peg (*choura*) driven into the ground. They complete the circle seven times from right to left, the bridegroom leading four times and the bride three times. This is really the essential part of the marriage ceremony, and they are regarded as married when this has been performed. But much else remains to be done. Still tied together, the couple are then taken to the village refuse heap (*ukeri*), in which previously one of the family has hidden a small basket (*potli*), two to three inches square, containing one pice, a betel nut, and a little rice. The bride and bridegroom are now required to search for this basket. If the bride finds it first the women of her family praise her, and suitably abuse the female relatives of the bridegroom. If fortune is with the bridegroom the women of his family pay the same compliments. The tarvi of the bride's village then proclaims as follows to the bridegroom's party :—"This girl has now been given to you. If her character is bad you must inform me. If any of you kill her by sword, or arrow, or stick, her family will take the revenge of blood. If she die a natural death, there will be no claim against you." The tarvis of the bride's and bridegroom's villages then drink together. The groom's party retires to wait on the outskirts of the village, and the bride is taken back to her home, where her hair is tied up and arranged by her mother. This is the last thing to be done, and she is then taken by her brother to join the groom's party. Accompanied by her brother, she returns with the bridegroom to his village, where the *ukeri* ceremony, or searching of the refuse-hill, is again performed. After this the friends and relatives separate to their homes and the couple are left in peace. It is considered proper that after three or four days the bride should return to visit her own family. For this purpose her relatives come to fetch her, and a feast is given by the bridegroom. She stays at her own home for about five days, and then finally quits it for that of her husband.

Each stage of the marriage ceremony is marked by special songs, sung by the women of the family, with the assistance of the minstrels (*dholis*) specially engaged. A collection

* A few eunuchs still exist in the Bhil country, and, indeed, throughout Native States. They are degraded Mohammedans, never Bhils.

I have made shows that they are usually vulgar, if not obscene, the main point being the abuse of the female relatives of the bride or bridegroom, as the case may be.

Those who are acquainted with Hindu, especially Rajput, marriage ceremonies, will probably find several points of resemblance to the Bhil ceremonial. The *mandwa* or pavilion, the touching of the *toran* or garland by the bridegroom with his sword, and the ceremony of circling the *choura* are essentially Hindu in their origin, and have doubtless been assimilated by the Bhils in the course of centuries of contact with the neighbouring Rajput races. Indeed it would seem probable that the patriarchal system under which a man worked for his bride in her father's house was originally more general, and that only with the increase of wealth and under unavoidable pressure of neighbouring Hindu influence, the complicated and somewhat expensive ceremonies I have described have been evolved.

I turn now to the funeral ceremonies. Infants are buried. In the case of adults also if the death is due to cholera, small pox, or leprosy, the body is buried—otherwise it is burnt. In writing of the Bhils, in 1820, Sir John Malcolm notes that they bury their dead, but except to the extent above mentioned, all my information goes to show that cremation is the ordinary system in force. The following is a description of the ceremony as now practised in the Jhabua State. The death is announced to the village by the firing of guns and beating of drums. The hair of the corpse is dressed as in life, and the body washed with water, brought in a new earthen vessel (*gharrah*) and clothed with new garments. A little dough is then mixed with the left hand and cooked on one side only. This is placed in a cloth at the side of the corpse. The spot in the hut where the man died is freshly plastered over with mud (*liped*) and a small lamp made of dough is set burning there under cover of a basket. A bier is prepared of bamboo poles, at the head of which cocoa-nuts are put, and the corpse is carried to the burning place, which if possible is near some running water. One pice ($\frac{1}{4}$ anna) is also tied in the clothing of the corpse to pay the rent of the land on which the body is burnt. This is not necessary when the body is that of a headman or a headman's wife. On the way to the burning-ground a piece of burning fuel is carried by a close relative, and if the deceased was an important person, guns are fired and drums are sounded. When the village banyan tree or other prominent tree in the neighbourhood is reached, the procession halts and rests. Each person in the procession picks a leaf of the tree, and these are all collected in a heap. The relatives also tear off small strips of the deceased's clothing and tie them on the branches of the tree. The new water vessel used for the washing of the corpse is carried to this spot and thrown on to the heap of leaves. If a widow is left she is brought here by the women of the family and her silver ornaments are removed. The lac ornaments are broken.

On arrival at the burning-ground the corpse is placed near water and all employ themselves in piling up the funeral pyre. The body, after being again sprinkled with water, is then placed thereon, its head to the north and feet to the south. The face is uncovered, and in the mouth is placed one rupee, a piece of the half cooked bread, a blade of grass and a little water. Minute pieces of sandal wood, or if that is not available, wood of the pipal tree, are then placed by everyone on the chest of the corpse, and the pyre is lighted by two near relatives, who while doing this turn their faces away. The corpse's ornaments, except those of gold, as also his bow and arrow, are burnt with him. Once the pyre is lighted the party retires to a distance and waits for some hours until the burning is finished, when all wash themselves and their clothing. They then return to the house, where a little bread and wine is taken, the latter by the men only. An agreement is then come to with the rest of the village as to the extent to which the death shall be celebrated by feasts, but with the family the period of mourning may be said to last for fifteen days. For the first three days the mourning extends to the village also, and no wedding can take place, nor will the actual participants in funeral ceremonies do any other worship to the gods. On the other hand, they will mix freely with the rest of the village, and there is no idea of that defilement which, in the view of the Hindus, follows from contact with those who are engaged in these ceremonies. For the first three days worship is done at the banyan tree, food being left there for the dead. On the first and second days also, the lamp under the basket is carefully kept burning. On the third day, the pyre is extinguished and the ashes scattered and thrown into water; the ground is also cleaned and plastered. Any bones that may have remained unburnt are washed and put into an earthen vessel and buried near the house. These,

however, are exhumed on the twelfth day and are then taken and thrown into the Narbada or any other of the larger rivers which flow through the Bhil country. On the third day also, the lamp is removed and carefully examined to find any marks there may be underneath it, as these marks are supposed to show the form of life into which the dead man has now returned. For instance, if in any way the shape of a man's foot can be detected, he has been reborn as a human being; if there is the resemblance of a goat's foot or a scorpion's tail, &c., then as a goat or scorpion. After this examination the lamp is thrown away and the whole house is freshly plastered inside with mud. Nothing is done from the fourth to the eleventh day, but on the latter a miniature pavilion or swing, or both, is erected by the heir near the house, and on this a ball of cooked rice is put. On the eleventh, twelfth and thirteenth days the heir is required to eat his food without salt. On the fourteenth day the rawals (minstrels) are called in to sing. On the fifteenth day there is a general feast, and on the sixteenth day all the relatives return to their homes. The rewards bestowed on the minstrels are on the following scale:—One hookah, one charpoy or string bed, nine cubits of cotton cloth, one pair of shoes, a calf, or five rupees. For every cocoa-nut broken, two annas; for every betel nut, one anna. If the family is rich, a mango or mohwa tree is in some cases also presented. A *pagri* is given to relatives.

A few words may be added in regard to the swing or pavilion which the heir is required to erect on the eleventh day. The intention is obvious, being for the repose of the soul of the deceased. Sometimes one finds on the side of a forest path a swing in miniature beautifully made of split bamboos, with a few grains of rice and pieces of cocoa-nut underneath, or a piece of thread stretched from the top of two bamboo sticks to represent the ridge pole of a hut. In other cases these erections are of natural size and of quite a permanent character. One I remember well. In this case the full-sized swing was suspended with iron rods, there was a long, stout bench for the body to rest on, and over this, supported by strong wooden uprights about the height of an ordinary hut, ran a strong piece of wire representing the ridge pole of the habitation where the spirit might rest protected from the elements.

In the case of a well-known and influential headman a permanent memorial is sometimes erected. These may take the form either of wooden posts driven into the ground, the tops of which are roughly decorated, or else what is known as a Ghatta or Tarvi stone, which is so frequently to be seen near villages in the Bhil country. The Tarvi stone is a flat slab of stone standing about 2½ to 3 feet out of the ground and bearing on one side a roughly carved representation of a Bhil riding on a horse. Though the Bhil in his natural state never rides, there is a widespread reverence for the horse both on account of legends which exist in regard to it, and also probably by reason of its rarity and value throughout the country, and hence presumably the great departed are exalted in this way. In one instance I heard of a stone representing the dead hero riding on an elephant, but this I believe is a unique specimen.

MINSTRELSY.

I have referred more than once to the rawals and dholis, the minstrels of the Bhils. These two classes are the repositaries of the Bhil traditions. They take the place of priests and are in request on all ceremonial occasions when they chant religious or heroic songs. The rawals are especially employed in times of mourning; the dholis at marriages or births, &c. The two classes are generally considered as having sprung from the Bhils, but as they have forsaken the normal independent Bhil life and taken to minstrelsy and begging, they are, though indispensable, now regarded as of a lower order. A Bhil will not marry with either of them, nor will he eat food cooked by them, though ordinarily they have no scruples on either of these heads.

A third, though somewhat more hybrid class of minstrel is the *barwa*. Prior to the British supremacy the *barwas* were primarily witch-finders and consequently a great power in the land. With the extension of law and order, however, their employment for this purpose has almost entirely ceased, and they have evolved into medicine men, and are called in to shriek their incantations at the bedhead of a suffering Bhil. The *barwas* are not a separate class, and any Bhil who feels the avocation innate in him and learns sufficient of the ancient songs may exercise the profession to its fullest extent.

TRADITIONS.

The Bhils possess no written records. It seems probable that their language was originally of the Munda stock, but at the present

time, as Dr. Grierson has noted ("Census of India, 1901") the dialect they speak is marked by a tendency to approximate closely to the local Aryan dialects in their neighbourhood; thus, on the western side, Gujerati, and on the eastern side, the Malwi dialect of Hindi have been largely absorbed, and the same applies to the southern districts, where the Khandeshi dialect has made itself felt. In spite, however, of this absence of uniformity and of a written tongue, the minstrels have maintained a large body of tradition. This is handed down by them from mouth to mouth. In addition there are the innumerable household songs, sung by women on family occasions which I have already mentioned. The minstrels go about in parties of five or six, each with a musical instrument. The leader recites a line or two of the song, which is repeated in chorus by the remainder until he starts a fresh line, which is again repeated, and so on through the whole story. In this way the song is learnt not only by his assistants, but also by the audience to a certain extent, and they readily join in the repetitions.

In a collection of these songs that I have made there are epic accounts of raids against the great Puar rulers of Malwa (A.D. 800 circ.) of similar contests with the later Mohammedan power, the Rajput chiefs of Udaipur, and so on; also quasi-religious stories based on the Puranic traditions.

One song that I heard had reference to an event which occurred twenty-three years ago, when the Bhils in the Ali Rajpur State rose against the Durbar, and the British authorities had to intervene to restore order. The author of the rebellion was one Jit Singh, a thakur of the State, who was discontented at the selection by the Government of India of Waje Singh, for the chieftaincy of Ali Rajpur. Jit Singh found ready allies in the turbulent Mekrani colony of Ali Rajpur, but probably nothing serious would have happened if general discontent had not at that time also existed amongst the Bhils, who formed ninety per cent. or more of the population. The chief was a minor, and the Diwan being incompetent, all power fell into the hands of his deputy, a man totally unfitted for his position. Owing to the neglect and carelessness of the higher officials, corruption and extortion extended to their subordinates. In order to make good a falling revenue, a number of small taxes were imposed on trivial articles. Land assessments were neither justly fixed, nor justly collected, and the headmen or patels, who, for several years, had not received their cash payments (*hakis*), were called upon to make good deficiencies of land revenue due to emigration. Finally, the *kallals*, or liquor contractors, were able, owing to the absence of supervision from headquarters, to encroach on the immemorial rights of the Bhils in the mohwa produce, thereby spreading discontent through all classes of the population. With the intervention, however, of the British authorities, the rebellion was rapidly quashed, and the leader of the Bhils — Chitu Patel — was eventually captured, and transported to the Andaman Islands, where he died. Such was the origin of the song which I heard sung at a dance a few years ago. The song compared the foolish patel, who led the rebels, to an ant who tried to walk with women's anklets on his feet, and the whole story of his temporary success against the local power, and his final destruction was most graphically and truly narrated. In this case the story had not passed into the hands of the professional bards, but was being chanted at a dance by a man whose father had taken part in the rebellion.

Future of the Race.

I have endeavoured to give, though I fear most imperfectly, an idea of this most interesting and attractive race. Much more might be written of their peculiar habits and customs, especially in regard to religious observances. The question of their future is also one of much interest, for though the mortality amongst them was very heavy during the recent famine years, they are in normal times a prolific race. Among the influences that are being brought to bear upon their future, are not only Hinduism and Mohammedanism, but also Christianity; and more than one flourishing mission exists in the Bhil country, where by force of example a certain number of these wild people are being induced to turn to steadier and more sober habits of life. Again, the standard of administration in the Native States in which they principally dwell is continually improving, and this also must inevitably react on them. Already their traditional rights over the forests, with the indiscriminate destruction which such rights brought with them, have been much curtailed, and it seems to me now largely a question of time that with sympathetic treatment they should gradually develop into a more settled community, possibly very largely Christian in its religion.

Eighty years ago, Sir John Malcolm when inaugurating the British supremacy in Central

India justly regarded them as a serious danger to the peace of the neighbouring territories, and he very clearly laid down the duties that lay on political officers in Native States to obviate this danger as far as possible by gaining their confidence, in ensuring them just treatment at the hands of the various Durbars. In the neighbouring British district of Khandesh, Sir James Outram's work in this connection is almost a matter of common knowledge. When this large area came into our hands in 1818, "murder and rapine stalked openly and unrestrainedly through the land." Fifty notorious leaders infested this once flourishing "garden of the West," and their every command was implicitly obeyed by upwards of 5,000 ruthless followers, whose sole occupation was pillage and robbery, and whose subsistence depended entirely on the fruits of their unlawful spoil. Smarting also under the repeatedly broken pledges of the former native government, and rendered savage from the wholesale slaughter of their families and relatives, the Bhils were more than usually suspicious of a Government of foreigners, and less than ever inclined to submit to the bonds of order and restraint.* The Satpura and Satmala ranges were infested with large bodies of warlike and disaffected men, and so insecure was the general condition of the lowlands that cultivators refused in many cases to accept the Government advances of grain for seed (*takavi*) on the ground that the crops, when ripe, would probably not fall to them but to the marauding Bhils.

For seven years every effort was made, principally by repressive measures, to induce a better order of things, but it was not till 1825 when Outram, then a Lieutenant, was appointed by Mountstuart Elphinstone, the Governor of Bombay, to carry out a definite policy of reclamation rather than extermination that any real reform or progress was initiated. Then, however, the progress was rapid. By gaining the confidence of the leading Naiks and commencing with a nucleus of nine men, he laid the foundations of the Khandesh Bhil corps, with which he subjugated and pacified the whole district. In April, 1827, he was able to report "that the peace of the country (South Khandesh) is restored." His Bhil corps was then 600 strong, and in the following year the Collector of the District reported to Government that for the first time in 20 years, the country had enjoyed six months of uninterrupted repose. In 1829 he advised the opening of a school for the children of his Bhil soldiers. In 1830-32 his operations were extended to the mountainous forest tracks along the northern borders of the district with the result that when he left Khandesh in 1835 there was general peace throughout the whole area, a peace which except in times of famine, or when broken by occasional exploits on the part of individual outlaws has since been maintained.*

It is natural in the Native States, where our influence must be exercised more or less indirectly, that progress should be less rapid than in a purely British district, such as Khandesh. But here, also, the instructions of Sir John Malcolm, and the traditions of Outram have had their effect, and though at the present time the Bhils are probably much more numerous in these States than they were then, and though they are still an extremely backward race, they are no longer a general source of danger, and certainly our influence amongst them is altogether paramount and their confidence in our good faith almost, if not wholly, unlimited.

LIST OF LANTERN SLIDES.

1. Bhils of the Vindhyan range. Malwa.
2. Bhils of aboriginal tribe.
3. Bhils showing method of fighting.
4. Bhils showing method of fighting, and also showing how the women give water to the wounded and are never hurt.
5. Bhils carrying off the wounded.
6. Bhils armed for a marauding expedition.
7. Bhil woman in full dress.
8. Bhil woman of Malwa.
9. Bhil musicians.
10. View in Bhil country with hamlet in distance.
11. Bhil dwelling.
12. Bhil dwelling, showing entrance.
13. Bhil dwelling, full view.
14. Bhil in native fighting costume.
15. A soldier of the Bhil Corps, Malwa.
16. Meywar Bhil Corps.
17. Officers and native officers, Malwa Bhil Corps.

Colonel E. D. F. Bignell (late Commandant Meywar Bhil Corps and Political Superintendent, Hilly Tracts, Meywar) kindly lent some of the photographs illustrating the paper and contributed the following notes :—

* Captain Douglas Graham's memoir.

* *Cf.* Goldsmid's "Life of James Outram," vol. i., pp. 51, *et seq.*

If a Bhil life is taken by a Bhil, he and the whole of the male members of his family, and his male relations are held responsible unless they pay the blood money, which they rarely do unless a British officer forcibly makes them. If not paid retaliation begins. A member of the killer's family is patiently tracked till he is caught off his guard, and, if possible, shot with a new arrow, highly ornamented and especially made for the purpose. A very shrill cry (*kilki*) is then given to inform the world in general that a blood feud has advanced another step, and the killer makes himself scarce, as it is now the turn of his family to lose a life. I have an arrow which was used in a blood feud with fatal results, and the tale of that blood feud will give you more information than pages of generalities. A Bhil in the Khotra district of Meywar woke up one night to find another Bhil trying to burgle his plough cattle. The burglar, when disturbed, let fly an arrow and decamped. The owner, enraged at this act, sent an arrow after the retreating figure, which hit and killed the man on the spot. The next day the dead man's relatives sent to say that as their man was killed when flying and not when fighting they demanded blood-money, or they would proclaim the *ver* or blood feud. The money was refused and the feud proclaimed. The man was a lonely individual, his entire family circle consisting of himself, his wife and two sons, aged four and two. Hence, for the time being, the feud could only go on with him, as, according to Bhil custom, until his sons grew up and married they were not liable. The man had several narrow escapes, and then died of cholera. Years passed, and the sons grew up till the eldest was eighteen, when he took unto himself a wife. The marriage ceremony lasted two days, and on the third he took her to his home, arriving late in the evening. He and his wife sat down by the fire, which was blazing outside the hut, whilst the mother sat in the doorway preparing the evening meal; suddenly the man pitched head foremost into the fire, scattering the sparks far and wide. His mother and wife fled shrieking, thinking a tiger had got him; but out of the surrounding darkness came the fatal "Kilki!" and they knew that the blood feud had claimed another victim. The corpse was brought in to me, and I found a new and very ornamented arrow had transfixed him, the feathers protruding from his left shoulder and the head from beneath his right ribs; death must have been instantaneous. I never could trace the actual murderer, but I got hold of the family, and forced them to go before a *punchayet* and adjust their grievances with the remaining boy, thus ending the feud.

Whenever anything unusual occurs a Bhil at once sends for the witch-finder, who assembles all the inhabitants of the *pal* and holds his investigation. The cause of his being sent for may be numerous deaths in a particular family or in the village, continuous loss of cattle, or mysterious sickness, in fact anything the mind of the Bhil cannot grasp. The witch-finder seats all the people, male and female, in a semicircle, and divines by counting the number of beans he takes out of a bowl or the number of grains in an ear of barley, &c., the tribal drums making a hideous din all the time. Suddenly he darts forward, and passes round the semi-circle of terrified men and women; backwards and forwards he rushes, getting wilder and wilder in his gestures, till he makes a pounce at a cringing figure, and drags him or her to the front. The fate of the suspected one is sealed. Ropes are produced, and fastened to her ankles; she is taken to a tree on the outskirts of the village, reserved for such purposes, and slung head down from a lofty branch; a pad of ground red pepper is bound round her eyes, nose, and mouth; a fire of green wood is lighted below her, and a big stone is rolled forward, so that it is more than probable her head will strike against it. She is swung slowly backwards and forwards, while the witch-finder, who is kept supplied, by eager assistants, with green wood sticks heated in the fire, applies them to her back or any tender part, and implores her to confess her guilt. The victim is practically never allowed to escape; if by any chance she does not knock her brains out against the stone, a slash or two with a tulwar puts an end to her misery and her witchcraft. Her remains are then buried nine paces from the tree.

In all tribal fights the women supply the wounded with water, and it is a point of honour amongst the Bhils that under no circumstances may the women be injured. I have seen them moving through a perfect rain of arrows yet not a single girl was touched.

The Secretary of the Section read the following communication from Colonel C. E. YATE, C.S.I., C.M.G.:—"I much regret that an accident prevents my attendance at Captain Barnes's lecture to-morrow. I have perused the advanced proof of his paper with interest, and there is just one point that Captain Barnes has not dwelt upon and which I should like to notice, and that is, the fine material for useful soldiers that we have in the Bhils. My time was spent more amongst the Bhils of Meywar, Dungurpur, Banswara, and Pertabgarh in Rajputana, than amongst those of Jhabua and other States in Central India, which have been specially described by Captain Barnes, and I know more of the Meywar Bhil Corps than I do of the Malwa Bhil Corps; but I believe both corps to be much the same. The Bhils are born trackers and scouts, lithe, wiry, little men, capable of long distance marching, and thoroughly faithful and reliable. The Bhils were faithful to us to a man in the Mutiny, and would be equally faithful again in case of any disturbance in India. They are so to speak the Gurkhas of Central and Western India, and just as the Gurkhas of the North have their permanent cantonments in the hills, so do the Bhils require their permanent cantonments in their hills in the South. The Meywar Bhil Corps, for

instance, has its cantonment at Kherwara in the Meywar Bhil tracts, and so long as that cantonment is permanently guaranteed to them, the Bhils will enlist readily. I believe that a second Bhil corps could be raised in Kherwara in a month at any time, should we require it, and a right valuable reserve we have there; and one never knows when more men may not be wanted. Should the Bhil corps be de-localised, however, and sent elsewhere, and their own cantonment at Kherwara taken away from them, the Bhils would never enlist. But why should this be done? We give the Gurkas local cantonments, why should we not give the Bhils the same? I mention this, as there is a craze for de-localisation of all local corps in India at the present time, which, if put into effect as regards the Bhils, will result in the loss to us of the entire Bhil country as a recruiting ground. In war, the Bhil will go anywhere, if only he is guaranteed the return to his own local cantonment at the conclusion of the war. The one thing he dreads is, to be deprived of his local cantonment in the midst of his own native hills, and as long as he is permitted to serve there in peace time, he will remain for us a valuable and faithful asset in time of war."

DISCUSSION.

The CHAIRMAN said that the one question which presented itself to thoughtful minds in all discussions of Indian subjects, was how far the British nation and its agents in India were fulfilling their trust and faithfully discharging the national duty to its peoples. The two papers already read before the Society this season brought home to us the wide differences between the various peoples of India. What a contrast between the Mohammedan Empire-builders, dwellers in crowded cities, and worshippers of one God, and the Bhil dwellers in isolated huts buried in the seclusion of the forests and totemists. The Bhils were a fair representative of the large class grouped as animistic, numbering 8,576,000 souls, of whom only 975 had ever learnt or were learning to read English. Yet they had their rights as well as the other classes of the 293 million fellow-subjects of the King, who, between them, counted 1,125,000 literates in English. To the animistics, British Indian laws and institutions were as much the home in which they lived as they were to Hindus, Mohammedans, Sikhs, Buddhists and others; and those who took an interest in devising fresh laws and constructing new constitutions for India, must take count of the human wreckage which immigration and disorders had cast up on the mountain ranges and forests of India. Captain Barnes's paper on the Bhils was an immense advance in knowledge gained on the paper read by Sir George Birdwood, in 1868, for Mr. Gibson, before the Royal Asiatic Society of Bombay, and it was a credit to the great political department to which the writer belonged. For the political officers in India had never been content with just doing the work before them and drawing their very modest pay. They had studied the habits and minds of the people amongst whom they lived, interpreted records on brass and stones which even the Indian residents of the State could not understand, and contributed valuable articles to journals and more permanent literature upon men and matters of which little was known. Captain Barnes was walking according to the best traditions of his great service. Perhaps he might have told us that the name of Bhil was derived from a Dravidian Kanarese word *billa*, signifying "bow," and he had underestimated the population of bowmen by not including the Bhilalas some 145,000, who were the result of marriages with other races. His account of the natural truthfulness of the Bhils was a new experience. He (the Chairman) had always heard that the Bhils were absolutely truthful if they swore by Baba Deo or the Raja's Gadi, or other holy names recognised by the various tribes, but generally untruthful in ordinary intercourse. But be that as it may, all authorities agreed that they were a most interesting people, timid, superstitious, idle, and happy, as well as patient and courageous. Such a people ought to have a future before them, and there was no doubt of their affection and loyalty to the British officials who deserved and won their confidence. When the Poona Peshwa staked his sovereignty, in November, 1817, on a treacherous attack upon Elphinstone and lost all on the field of Kirki, dominion over the Bhils of Khandesh and Gujerat passed into British hands. They were then reputed to be the most unmanageable of human ruffians, enemies of society, incapable of discipline. The Brahman rulers of Western India had made them what they were, for they knew only one method of dealing with them—extermination and torture. In 1804, 7,000 Bhils were inveigled by Balaji Lakshaman, the Peshwah Governor to Kopargaon, and then thrown into wells and left to die there, wounded and maimed. Two years later Naroba organised a grant beat in the jungles, and in fifteen months he reported that he had massacred 15,000 of them. The most brutal tortures were inflicted upon those who were captured. No wonder then that those who survived cherished undying hatred ot the Poona Government, and ravaged the villages in the plains whenever they could. No wonder that they disbelieved at first in the promises of British officers and would have no communications with them. But after a short period of reprisals and punishments, the British in 1825 resolved to try a new system. Outram, the Indian Bayard, was authorised to enrol a corps of the bowmen, and to establish colonies of them in convenient spots for agricultural operations. His first step was to catch some Bhils alive and red-handed, then he set free some of his prisoners, promising to release the rest if they would return with their families. The Bhils found the Englishman true to his word, and his next step was to trust himself alone in their company anp join them in the chase. After a while five Bhils

attached themselves to him, and on January 1st, 1826, 134 had joined his corps which presently increased to over 300 men willing to remain in barracks. In 1828 Giberne, the collector, reported that for six months no attacks had been made by Bhils on the province. Gradually the tribesman settled down to agriculture, received loans of money, and found the industry fairly remunerative. At times some sudden fancy or inexplicable movement has caused some of them to revert to the old nature, as when in 1882, a party rebelled against the authorities in Pol, and attacked the carriage of the Political Agent on the Ahmedabad Idar road. But the temporary detachment of two companies of a native regiment was sufficient to restore order. More difficult has it been to attract them to relief works in times of famine when their superstitions have been stirred, and they have put their trust in their gods and totems rather than in the relieving officer. But still matters have advanced so far that the Bhil corps in Khandesh has been disbanded, and the special Bhil agencies are now threatened with extinction. It is believed that the Bhils have been reclaimed, and are fit to take their place as citizens of India, under the fostering care of the regular district officers, provided that suitable officers, fond of sport and favourably disposed towards the Bhils, are put over them—such as Ashburner and Propert (Raja) in the past, and others now in the service of Bombay. These measures for abolishing institutions, which have worked well, require careful watching. As to the future, more must be done by education, and by raising these animistic tribes to a higher conception of God and religion. In this, missionaries are taking their part, and a wide field for conversion is open to Hindus, Mohammedans, and Christians. There is much in the Bhil character that appeals to humanitarian sentiments, whether we look at their state of ignorance, or the trials they have endured in the past. Captain Barnes's sympathetic paper shows that our officers try at least to understand these bowmen, and we may rest assured that the interests of eight and a-half million animistic subjects of His Majesty will not be forgotten by a paternal Government in shaping the future development of Indian laws and institutions.

Colonel T. H. HENDLEY, C.I.E., remarked that he was particularly interested in the paper, because thirty-six years ago he was the Medical Officer of the Meywar Bhil Corps, the head-quarters of which were at Kherwara. In 1875 he read before the Bengal Asiatic Society a paper on the Meywar Bhils, and he had, therefore, been exceedingly pleased to hear the extremely accurate account given by Captain Barnes of the Khandesh and Malwa Bhils. Although the paper referred particularly to Malwa and Khandesh, many of the illustrations were taken from the Kherwara Bhils. With regard to the ethnology of the people, he had measured the skulls and the principal bones of more than a hundred men in the Meywar Bhil Corps. Measurements were carefully made and compared with those of other tribes, bu he did not recollect that any very definite information was obtained. The head of the Bhils, however, was broad instead of being long like that of an ordinary Hindu of the plains. Another interesting point was the language of the people, which had been particularly studied by the late Rev. Mr. Thompson, of the Church Missionary Society, Meywar, in the Hilly Tracts. Mr. Thompson came to very much the same conclusion as himself, namely, that the language of the Bhils varied in accordance with the tribes in the immediate neighbourhood. There were certain elements in the language which were not of Sanskritic origin. With regard to the question of the origin of the Bhils, the author had made reference to the Bhils having been derived from certain rubbings which took place on the dead body of the Raja of the Earth. If he (Colonel Hendley) had known that views were to have been shown, he would have brought with him a lantern slide which represented the artist's idea of the creation of the Bhils. It represented the corpse of King Venu being rubbed by the sages, and his vices coming out of his leg in the form of a Bhil, very much of the kind described in the paper, while his virtues came out of his hand in the shape of a fully-armed Rajput. The author had referred to the truthfulness of the Bhils, and he remembered stating in his own paper that truth was very characteristic of the race. The fact was probably due to the simpleness of the people. Before the Meywar Bhil Corps was established in 1841, and in the very early days of the corps, the Bhil, when he was questioned, always spoke the truth at regimental enquiries. But, unfortunately, he had learned to lie with the advent of Brahman native officers who had taught him his drill. With regard to the women, they were no doubt very much the masters of the situation, but he was able to narrate a curious story which, he was sorry to say, illustrated the want of faith in Bhil women. One of the men in his corps, who was acting as a beater to a shooting party, was shot in one eye by a small pellet, the sight being completely destroyed. On the man coming to Kherwara, he (Col. Hendley) suggested that the only way to save his other eye was to remove the damaged one, but the man replied that his wives, of whom he had seven, stated that they would not support or remain with a one-eyed man, because a one-eyed man was generally considered unlucky all over India. They promised, however, that if he lost the other eye as well, that they would support and remain with him. The man did eventually lose his other eye, whereupon all his wives immediately deserted him! Reference had also been made to the brass ornaments worn by the Bhil women. He had often seen Bhil women having brass ornaments fitted on their legs by a blacksmith, one of the most characteristic ornaments being W-shaped. That particular shaped ornament was only worn by married women, and it was removed from them when they became widows.

It was a rather curious fact that, among the Bhils, there were a good many old maids, which was rather different from the state of affairs in the Hindu community. Many other customs were mentioned in the paper, which showed, he thought, that the Malwa Bhils and the Western Indian Bhils were more Hinduised than the Rajputana Bhils. The author had also made reference to horses, in connection with which a rather curious religious idea was associated. On the tops of the hills, little cairns were frequently to be seen full of clay horses, with a large opening at their backs, the idea being that when the Bhil died, his spirit went into the horse, and ascended so far on the road to heaven. Heaven was considered to be within the compass of twenty horses' journey or so; thus if the Bhil put up twenty horses during his lifetime he was well on the road to heaven. That was not only a belief in the Meywar tracts, where his own observations were made, but it was also noticed in other parts of India. A paper was read some time ago in which the author referred to a similar collection of horses in the neighbourhood of the battlefield of Plassy and in other parts of Bengal. The marriage customs narrated by the author were very much more Hinduised than they were in his (the speaker's) part of the world, where it was only necessary for an old man of the tribe, or an old fakir, to unite the couple, and after certain feasts and other ceremonies the contract was completed. The remarks that had been made on the subject of cremation were perfectly correct; in fact, the one point which struck him about the paper was its extreme accuracy on all points on which he had any knowledge. What the Chairman had said with regard to the disorderly state of the Bhils was no doubt perfectly true, but much of it was the result of oppression. Mr. Thompson in his book gave a long account of the cruel way in which the Mahrattas persecuted the Bhils in the southern parts of Rajputana. There was a mixture of cruelty and kindness, even in the treatment of the Rajput overlords, so that one of the most beneficent things the British Government ever did was to establish local regiments. The wild spirits among the Bhils very soon enlisted in the Bhil corps, and in his own time there were generally two or three hundred "expectants," as they were called, who were waiting in the hope that they would shortly be taken into the corps. There was one difficulty connected with such local regiments, namely, that the Bhil would not be likely to serve except under his own officers whom he trusted, nor would he be prevailed upon to go a long distance from home. They had a very curious custom that the men kept their wives and families in their own villages, and when they obtained two or three days' leave they travelled sometimes as much as thirty or forty miles to join their families in their particular villages; so that if the head-quarters of the regiment were a long distance off, it would be impossible for the men to do that. With regard to the question of the Christianising of the people, he remembered that a Hindu reformer rose up in Meywar some 35 or 40 years ago, who had a great influence over the Bhils, and when he died he foretold that the Bhils would change their religion, saying, "On the spot where we are now sitting a place of worship of a new religion will be erected. You will worship the God of this religion with a new name. It will take place 'When a certain tank near by shall be repaired.'" This tank was repaired during the famine of 1902. That place was now the centre of a very large Christian mission, founded by Mr. Thompson, in the schools of which 3,500 children were being educated, and it was very interesting to note that the present clergyman of the mission bore the honoured name of Outram. In conclusion, he had no doubt that many Anglo-Indians would find that their knowledge of a very interesting people had been greatly enlarged through Captain Barnes's excellent paper.

Mr. IAN MALCOLM said he would not like to leave the meeting without saying how grateful he was to the author for the very admirable paper he had given upon a subject on which a good many people were still in need of information. He could not help feeling that the Chairman struck the right note when he referred to the paper as being not only an important one with regard to the Bhils, but an example of the innumerable variety of tribes in India which were ruled in the name of Great Britain. Sir William Lee-Warner had struck in his (the speaker's) heart a responsive chord in the tribute he paid to those who ruled over such a variety of races, and he should never lose an opportunity of paying his highest tribute of admiration and respect to the members of the Indian Civil Service, without whose magnificent services, day by day, and night by night, he did not think British rule in India could continue very long. The one or two remarks he desired to make were entirely complimentary in character and not at all critical. The Bhils with whom he had become acquainted in the course of travelling through India were the Rajput Bhils; and he entirely agreed with what had been said about their bravery and courage, and largely with what had been said about their truthfulness. The last time he saw much of them was during the frightful famine of 1901; and, animistic and totemistic though they were, the way in which the Bhils of Rajputana bore their privations was beyond all praise. He was glad to join in a tribute paid to their bravery during the famine. Reference had been made in the paper to the fact that gaiety was one of the characteristics of the people. He remembered when he was in Udaipur in the previous year having a conversation with some Banias, and a lady who was present said she had never seen a Bhil, and would like to do so in order to get a photograph. Accordingly a Bhil was brought from a neighbouring garden with his bow and arrow. A mischievous idea struck one of the party, who said to the Bhil, "Show us what you would do to the Bania if you met him on a dark evening." Before one could say "knife," the

Bhil had tied his puggaree across his face so as not to be recognised, had butted the poor Bania in the pit of the stomach, knocked him down, taken his bag and his turban, and getting behind him, had drawn a bead with his bow on the prostrate Bania. That was a Bhil's idea of a joke. When he was staying at Mayo College last winter, he saw one of the young princes who ruled over a large number of Bhils, and he showed him one volume that he had already written in excellent English of the history of the Bhils, which he was now preparing and hoped to have ready for publication by the time he was twenty-one. Personally, he thought it would be a very valuable book, and those people who knew anything about the Bhils would probably be the first to pay their tribute to it. He thought it was a marvellous thing that a boy of 17, who was at school at the present time in India, could write a book which any author in England would be proud to be able to write. The chapters written by the prince were appearing three times a year in the *Mayo College Magazine*, and if any of those present ever had the opportunity of reading them he was sure they would agree with him as to the excellent manner in which they were written.

On the motion of the CHAIRMAN, a very hearty vote of thanks was accorded to Captain Barnes for his interesting paper.

Colonel DUNCAN PITCHER writes:—As time would not admit of my joining in the discussion which followed the reading of Captain Barnes's admirable paper I beg to submit a few remarks for inclusion in the *Journal* should space permit. The cost of the Malwa Bhil Corps is borne, practically, by the following Native States—Gwalior, Dewas, Dhar, Jaora, Jhabua, Barwani, and Ali Rajpur, who between them pay about Rs. 4,15,585 per annum, the British Government contributing only Rs. 9,828 per annum. Holkar formerly contributed but compounded a few years ago by a payment in cash. Now that Sirdarpur has been abandoned as a station and the corps transferred to Imperial service at Indore with detachments at distant Nowgong and Sutna in Bundelkhand, while the Native States in question are deprived of the security from Bhil aggression and unrest which their contributions were arranged to insure, those contributions should surely be remitted else our good faith may run risk of being doubted. When a proposal was made by the Supreme Government to Sir Arthur Wellesley which, to his mind, involved a breach of faith towards the vanquished Dowlat Rao Sindia, Sir Arthur replied in so many words that he would rather our possessions were lost than our reputation for good faith. A friend who witnessed the final march out of the Bhil Corps from Sirdarpur describes the scene as a most trying one from the crowds of wailing women and children who followed for some two miles and had at last to be forcibly driven away. Desertions had begun and are likely to continue.

NINTH ORDINARY MEETING.

Wednesday, February 6th, 1907; Professor HALFORD JOHN MACKINDER, M.A., Director of the London School of Economics and Political Science, in the chair.

The following candidates were proposed for election as members of the Society:—

Clarke, Allen H., 74, Inverness-terrace, W.
King, Captain Alexander E., R.A., Ordnance Office, Citadel, Cairo, Egypt.
Mansell, Major John Herbert, R.A., 108, Shooters-hill-road, Blackheath, S.E.
Prevatt, Francis C., 106, Henry-street, Port of Spain, Trinidad, British West Indies.
Tanner, William Hugh, Public Works Department, Mombasa, British East Africa.
Weston, Robert Ogilvy, M.Inst.M.M.,A.M.I.Mech.E., The Globe and Phœnix Gold Mining Company, Limited, Que Que, Rhodesia, South Africa.
Yate, Colonel Charles Edward, C.S.I., C.M.G., 17, Prince of Wales's-terrace, W.

The following candidates were balloted for and duly elected members of the Society:—

Bancroft, Augustus Charles, J.P., F.S.I., Stokes-hall, Plantain-garden River P.O., Jamaica, British West Indies.
Cooper, Hon. Francis Alfred, C.M.G., M.Inst.C.E., Director of Public Works, Colombo, Ceylon.
Freehill, Colonel Francis Bede, M.A., Martin-place, Sydney, New South Wales, Australia.
Gordon, Walter, P.O. Box 96, Harrismith, Orange River Colony, South Africa.
Ikébé, Kichitaro, The Tokyo Asahi Shimbun, 4, Takiyama-cho, Kyobashi-ku, Tokyo, Japan.
Rich, William, Trevu, Camborne, Cornwall.
Smith, Milton W., 413, Failing-building, Portland, Oregon, U.S.A.

The CHAIRMAN, in introducing the reader of the paper, said that the subject to be discussed was one which was daily occupying more attention, householders at the present moment being particularly interested in one of its aspects; indeed, he occasionally thought that some of the aims of Socialists would be accomplished through insurance without abandoning the individualist basis of society. Everyone would agree that it was of the greatest importance that the whole profession connected with insurance should be such as could be trusted, not only for their skill, experience and knowledge, but also their probity. The education of gentlemen belonging to the actuarial profession was being much discussed at the present time, and it was therefore a matter of great interest that so distinguished an ornament of the profession as Mr. Young was to read a paper on a very wide subject connected with it.

The paper read was—

THE PRINCIPLES AND PRACTICE OF INSURANCE AND THEIR MODERN DEVELOPMENTS.

By Thomas Emley Young, B.A.,
Past President of the Institute of Actuaries, and Past Chairman of the Life Offices Association.

"On all great subjects," remarked John Stuart Mill, "much remains to be said;" and Coleridge has inspiringly pointed out* that the redemption of inert truths to regenerated vigour is won by their incarnation into forms directly related to man's personal and social circumstances and needs. I am encouraged by these sayings in my attempt to confer some freshness upon the familiar subject of insurance, by combining its theoretical aspect with its practical agency in our social and commercial system.

You will remember one of the striking antitheta of Lord Bacon, "Fama veluti fluvius levia attollit, solida mergit."† Like most similes derived from physical Nature, its importation into the domain of human activity is of precarious value; and, as in all epigrams, the completeness of truth is sacrificed to brevity and symmetry of literary form. Still, the metaphor is not useless, and history frequently testifies to its validity. Our subject affords an exemplification. We possess the story from Aristotle of a financial transaction in olives, successfully effected by the founder of the earliest Greek school of mathematics, Thales,‡ which formed the first known commercial "corner" in business, while the subject of deeper human import, insurance, can point not even to a legendary example of its primitive forms. It is true that Mr. W. E. H. Lecky, in his "History of European Morals,"§ informs us that among both the Greeks and Romans, mutual "insurance" societies existed which undertook to provide for their sick and infirm members, and he cites Pliny's Epistles as his authority. If you care to refer to the Letters, numbered xciii. and xciv., which passed between the Emperor Trajan and his Consul, Pliny,‖ you will discover that the society, for whose establishment Pliny pleaded on behalf of the city of Amisius, was simply a charitable institution for the support of the indigent. And the learned Casaubon aids us here by showing (in a citation from an ancient commentator) that, in Athens and other cities in Greece, fraternities were founded where monthly contributions were paid into a common chest, from which pecuniary help was granted to necessitous members on condition that, on the advent of more propitious fortunes, the moneys so advanced should be refunded. Mr. Lecky, accordingly, is inaccurate in the employment of the term "insurance" as applied to ancient history. Societies of this nature were merely related to the scheme of insurance so far as insurance is founded upon that feeling of mutual co-operation which humanity and the requirements of civilisation suggest and enjoin. I am naturally referring here to that crude form of insurance which involves the mere mechanical sufficiency of numbers to produce average and balancing results even without the element of interest, and, of course, without the introduction of the systematised principles of probabilities: in other words, the form of insurance which common sense and general observation of the stability of large numbers would indicate. For the organised system of insurance, as we properly conceive it, only became practicable when the calculus of probabilities had been created. And as the illustrious Laplace observed, it forms a most memorable and instructive fact that a science,—that of probabilities,—begun as a mere computation of chances connected with the events of gambling hazards, should so expand in its manifold amplitude of practical serviceableness that it has become, not simply ancillary to mathematico-physical problems but the valid foundation of social organisations of the profoundest import and scope. A moment's reflection upon the range of marine insurance, for example, will suffice to show the restricted area to which commerce with its civilising functions would have been confined if this doctrine of the constancy of recurrent results which extensive numbers involve, based upon the universal principle of continuity in Nature, had never been evolved and expressed in numerical forms. It has always impressed me with wonder that the subtle mathematical genius of the Greek which devised the Method of Exhaustions (exemplified in Euclid, Book XII., Proposition 2, and essentially embodying the principle of Newton's Method of Limits and the Calculus of Leibniz) failed to discover the science of Probabilities. Was it that the

* "Aids to Reflection": Aphorisms I. and II.

† Section X. of the "Exempla Antithetorum" (De Augm. Scien., Book 6, chap. 3).

‡ Ball, "A Short Account of the History of Mathematics," chap. 2.

§ Volume 2, chap. 4.

‖ Edition by W. Melmoth (1805); Vol. ii., Book x.

conception of a universal Fate obstructed the adventure? For they were intimately acquainted with games of chance, and their dice-playing with ἀστράγαλοι and κύβοι* frequently reduced the gamblers to ruin. It was reserved, however, for the versatile Pascal, in 1654, to establish the principles of the theory of probabilities by solving a problem submitted by a gamester relating to the proportionate division of stakes where two players of equal skill, after each had gained a specified number of scores, decide to abandon the game. That problem of Points—as it is termed in the history of mathematics—furnished the origin of the principles on which the practical execution of insurance is effected. For a time the theory was restricted in its application to regulate the stakes and expectations of games, but Jacob (or, as he is usually called, James) Bernouilli appears to have been the first to suggest that the phenomena of the physical and moral universe, exhibiting though they do, anomalies and irregularities when surveyed in fractions, reveal, when a spacious range of view is adopted, so marked a uniformity of coincidence and succession as to render them amenable to numerical estimation. In his "Ars Conjectandi"—arrested in completion by his death and published as a fragment in 1713—he enunciated the important Proposition of Large Numbers† (as it was appropriately named by the mathematician, Poisson). As this theorem constitutes the main foundation of systematic insurance, a brief explanation of its nature and significance may be offered. If a series of trials be instituted respecting any event which must either happen or fail at each occurrence, the probability continually increases, with the extension of the trials, that the proportion of occurrences of the event in a specified mode to the total number of trials will be equal to the ratio shown at a single trial. A familiar illustration will be useful. If a justly-balanced coin be spun in the air, the chance of head appearing in a single trial is obviously one-half; a dictum of commonsense where no *à priori* tendency or preponderance in favour of head or tail exists. This fraction expresses the ratio of the favourable event to the sum of the possible events. Now it is found that as the trials are augmented, precisely the same ratio tends to prevail, and as this tendency increases with the extension of the trials, it holds exactly in the limit when the trials proceed to infinity. Thus, the naturalist, Buffon, obtained 2,048 heads in 4,040 trials, or 50·69 per cent.; another experiment showed 2,048 heads in 4,092 instances, or 50·05 per cent.; and Mr. Karl Pearson has recently recorded in another set of 12,000 trials 49·84 per cent. of heads, and in an extended set of 24,000 trials 49·95 per cent. Thus, the more enlarged be the area of the experiments, the more closely does the total ratio approximate to the result exhibited by a single trial, of 50 per cent., or one-half.

What does this signify in connection with the application of the theory of probabilities to life assurance? The probabilities of life and death obviously are inapplicable, from the nature of the case, to *individuals* who in this science can only be regarded as constituents of a *mass*. Suppose then that we select an adequate number of boys of the age of 10, and find that out of 2,000, 1,929 survive to the age of 20; we are confident that practically the same ratio will exist when the numbers at the younger age amount to 10,000, and closer still if we survey the whole of the children of 10 in a century, assuming that the social condition and other circumstances reasonably correspond. Hence, our fundamental mode of operation may be exhibited in an example. A table of mortality shows, out of a stated number born, the numbers who survive to each successive age until all have become extinct, and the difference between the number so living at any one age and the number living at the next higher age furnishes obviously the number who have died in that particular year of age. The number existing at age 25, extracted from the table of mortality which now forms the standard for assurance companies (with the numbers proportionately modified for convenience of treatment), is 3,146, out of a certain larger number born; the number living at age 26 is 3,131, so that 15 have died during the year. The chance of death, accordingly, in that year, is measured by the number of cases favourable to death, or 15, divided by the number of 3,146 who, starting at age 25, must either live or die during the ensuing year; the chance, therefore, is about five in 1,000. So that if a company assures a life for one year at age 25 for £1,000, the value of the risk it incurs, and, therefore, the price to be paid by the assured, is the sum to be received multiplied by the probability of receiving it, *i.e.*, by

* Becker's Charicles, 6th Scene, Excursus iii.

† Bernouilli himself stated that the solution of this theorem occupied his mind for 20 years, and certainly that prolonged time was worthily expended in devising this efficient instrument by means of which the vast social scheme of insurance has been securely erected.

the chance of death, or £1,000 × ·005, or about £5. But as the company will obtain one year's interest upon this price the cost to the policy-holder must be reduced by the discount for one year, usually assessed at 3 per cent. The present price for the company's risk of payment during the second year, *i.e.*, from age 26 to 27, is obtained by multiplying the chance of the life aged 25 surviving to age 26 into the chance of his dying in the ensuing year, discounted again for two years, since in the theory of assurance the sum assured is payable at the end of the year of death or, on the average, six months after the date of death. This process being repeated for every separate year to the extreme term of existence furnished by the table of observations; and the several individual values being summed, the total constitutes the single premium for the risk attending an assurance for the entire period of life. When that premium is increased by additions representing the contribution to expenses of management, a provision for possible adverse fluctuations of experience, remuneration for the protection of the proprietary capital (where that exists), and, in respect of participating policies, by an assessment to the profits in which (accumulated at interest) they are successively to share, we obtain the single premium charged to the public. This is readily converted into a precisely equivalent annual amount.

Here again let me interpose a caution to which I have already referred, and which some of our ablest mathematical writers have, through carelessness of diction, failed to observe. We cannot, from the necessity of the case, calculate the chances of life and death in *individual* instances; the probabilities I have explained cannot express the probabilities or expectations of a *particular* person surviving the successive ages, or dying during their currency; but our propositions, when related to individuals, should thus be interpreted,—that if we assume a sufficient number of persons at the age of 25, *e.g.*, then the chance of attaining the ensuing age is 995 to 1,000. We deal exclusively and consistently with the conception of large numbers involved in Bernouilli's theorem, and apply our calculations to a mass and not to the unit. It is true that, when effecting a life policy, an individual contract is completed, but the premium charged is deduced from the experience of extensive numbers of persons as an average result, so that the quoted premium does not measure the risk attaching to the assurance of an *individual* policy-holder of the stated age, but the risk appertaining to a number of policy-holders of that age among whom the individual in question is included. The consequence is that, as the essential basis and implication of the scheme, those who reach the higher ages necessarily, by their more numerous payments of premiums, contribute in excess to the discharge of the earlier claims in connection with which few premiums have been received, and thus the conception of an average is realised.

The guiding principles affecting the statistical foundation of life assurance—and the remark obviously applies to other descriptions of insurance—are (1) the sufficiency of numbers, and (2) a congruity of nature in the materials which constitute the data—in life assurance, *e.g.*, this congruity will include racial, social, and physical conditions. The first criterion is involved, as I have stated, in the conception on which Bernouilli's theorem is based as the necessary condition of the stability of results.* In respect of the second principle, Dr. Whewell† has illustrated the requisition in science of the Appropriateness of the Ideas which are to be applied to each department of investigation; and it is of deep interest to observe that our illustrious countryman, Dr. Edmund Halley, the first predictor of the return of a comet within our skies, the first to suggest the employment of observations of the transit of Venus in the determination of the sun's distance from the earth, and, crown of all, the efficient cause of the world's illumination by Newton's "Principia," was also the pioneer‡ in proposing that the appropriate ideas in the tabulation of numbers as the basis of a table of

* I regret to remark that I have known instances of the violation of this imperative principle by actuaries themselves. I have seen a valuation of the liabilities of a society where the total number of members was less than 30! In other words, the application to this utterly inadequate number, of functions of value deduced from a mass of observations is entirely delusive, and the results obtained and judgment expressed absolutely worthless. We perceive this grave absurdity in other forms of statistics—which I have elsewhere described as the fallacy of percentages. It is stated, *e.g.*, that 50 per cent. of the persons attacked by a particular disease have died; but any alarm or significance will be dissipated when we remember that one death out of two attacks constitutes equally a percentage of 50 as 500 deaths resulting from 1,000 attacks. Hence we derive the practical maxim that percentages should never be accepted as conclusive or material until the aggregate number out of which those percentages are constructed, have been ascertained and weighed.

† Nov. Org. Renov. Book II., chap. ii., section iv.

‡ "Phil. Trans.," Vol. xvii.

mortality consisted of fundamental similarity of data,* and the discrimination (in the premiums) of age. The absence of conformity would be manifest if we promiscuously combined into one table of mortality the experience of different races with their discrepant conditions of life, and varying ancestral types of heredity affecting the chances of longevity; or if, in a table intended for the assurance of male lives, were incorporated the experience of females, whose lighter mortality would thus depress the premiums below their properly relevant level; or, again, in the inclusion of the records of annuitants in the formation of a standard designed for the estimation of assured lives alone. Assurance companies have, for a considerable period, and never so exhaustively as at the present time, precisely observed this condition of consistency by the adoption of a table of mortality deduced exclusively from the experience of lives previously assured.

It is obvious that the records of the past constitute the most appropriate measure of the future as regards the nature and indications of the data to be employed.† I may here interpose a specific observation upon this congruity of materials. Regarded throughout the entire duration of life, females exhibit a higher vitality than that of males; and one company (still in existence) thence determined that it was unjust to demand identical assurance premiums from the two sexes. Females were, accordingly, admitted upon more favourable terms than males; but experience of their mortality speedily and decisively compelled the abandonment of the experiment. For it has been found that, during the period of child-bearing, the mortality of women exceeds that of men, but, after the age of 50, the vitality of women so markedly surpasses that of men that the superiority cancels, so to speak, the enhanced mortality of women during the stage I have named, and confers upon them, in the complete duration of life, an augmented longevity. Now as assurances upon female lives as upon males are effected during this more dangerous prior period, the foresight of the actuary who suggested this innovation thus received a signal practical rebuke. An important example of incongruity of data and its financial results may be cited from our national history. In 1819, Mr. John Finlaison, the Government actuary, reported to the Chancellor of the Exchequer, Mr. Vansittart, that the scheme of granting annuities for the purpose of creating public funds, on the basis of the Northampton Table of Mortality, involved the national exchequer in a serious annual loss. The Northampton Table had been constructed in 1771 from the mortality-experience of the inhabitants of that town, and when the practice of raising loans by the issue of life annuities was adopted by the Government in 1808, an actuary, Mr. William Morgan, was consulted, and prepared rates of annuity on the basis of that table. Its peculiarity consists, speaking generally, in its heavy rate of mortality and its consequent inapplicability to female life, and since annuities are mainly purchased on the lives of selected female nominees on account of their superior prospects of longevity, and purchased, moreover, after their dangerous period of life has been survived, this incongruity of basis resulted, in the 11 years from 1808 to 1819, in an aggregate loss to the country of £2,000,000 of money.

An essential principle of life assurance is the regulation of the premium according to the probabilities of life at each specific age. At age 25, the chance of dying within the space of the ensuing year is about 5 in 1,000, while at age 55 the corresponding chance is about 20 in 1,000, or four-fold; the variation consequently in the values of the risks demands a relevant discrimination in the prices required for the assurance of those risks. An ancient and honourable society—the "Amicable" (established by charter in 1706, and merged into the "Norwich Union" after

* If I had not more strictly confined this lecture to the history of assurance, and its associated science, as dependent upon British enterprise and research, I should have cited the conception of congruity exemplified by Deparcieux, when, in 1746, he constructed a table as an instrument of measurement of the mortality of annuitants, from the experience of the deaths which had actually occurred in this special class among the tontine nominees in France. And also the similar directing notion of the Grand Pensionary of Holland, John de Wit, who, in 1671, presented a report to the States-General of Holland, in connection with their decision to raise public funds by the issue of annuities, in which he based his statistical and monetary suggestions upon the congruent foundation of the course of mortality ascertained to prevail among the grantees of annuities already purchased in Holland from the Government.

† Although a table of mortality expressive of the experience of an adequate numbet of assured lives in general is justly and appropriately adopted in calculating the value of the liabilities of any particular company of reasonably similar conditions, it is clear that, since companies differ to some extent between themselves in respect of the distinctive character of their experience, the theoretically accurate plan, if this separate experience be sufficiently extensive, would be for each company to tabulate its individual records and utilise them as the basis of its computations and assessments. This course, however, though undoubtedly theoretically correct, is practically needless in consequence of the prevailing general identity of the several experiences on the whole.

an existence of 161 years) violated this essential condition by charging the same rate of premium at every age, and thus heavily oppressed the younger and more vigorous members for the inequitable benefit of those of advanced ages. The premium for the risk of death under a whole-life policy at the age of 25 is £1 10s. 6d. per cent. (assuming a basis of interest of 3 per cent.), while at 55 it amounts to £4 12s. 10d. per cent., or 204 per cent. in excess—an excess measuring the extent of injustice thus committed upon the younger lives. It was not until the "Equitable" (still in prosperous existence) was established in 1762 that the premiums were adjusted as direct functions of the several ages under the advice of an able mathematician, Mr. James Dodson.

In the practical computation of assurance premiums the amounts directly deduced from a table of mortality are simply sufficient to provide for the risk of death, and, as I have stated, are then augumented by the addition of a quantity (composed of a constant and a percentage), incongruously termed the "loading," for the purposes which I have already described.

And now we arrive at the consideration of a factor as essential as the rate of mortality, the force of compound interest, but I shall treat this subject more effectively if I proceed at once to the sources whence the profits of life assurance are derived. These comprise—

(1.) A lighter mortality-experience than that anticipated and provided-for in the premiums and valuations. This source is of comparatively insignificant dimensions, for if a measure of mortality has been selected in consistency with the experience which has actually occurred, the beneficial fluctuations of one period will, on natural and intelligible grounds, be succeeded by adverse oscillations at a subsequent stage, and *vice-versâ*. And the meaningless statement recited in the annual reports of many companies that the actual deaths have proved inferior to the number expected is a mere delusion as regards surplus from mortality, which should long ago have disappeared from the records of any office where precision of language is the reflection of reality of fact. The case in which a permanent profit would be realised from mortality would occur where the premiums were based upon a rate of death known to be intrinsically superior to that likely to prevail among the specialised class of members admitted into the society. This exception occasionally presented itself in former days in what were then termed "class" offices—offices, that is to say, which appealed with virtual exclusiveness to a particular section of lives, clergymen, *e.g.*,—but it no longer exists since, in compliance with the necessities of competition, these isolated societies have expanded their range of membership, though still endeavouring to retain, in this wider scope, the standard of acceptance which originally constituted their characteristic and determinate rule. In the experience of a prominent company—the sole evidence of the kind which has been published, though it is undoubtedly confirmed by the records of other offices—the surplus from mortality, determined upon a recognised mode of assessment, amounted, during a period of 20 years, to about 12 per cent. only of the entire profit realised.

(2.) A genuine profit arises from economy of management, and is dependent upon precisely the same conditions as those which prove effective in any department of commercial industry—the trained sagacity and skill of the administrator, and the rare capacity, in imitation of the universal formula in nature, of employing the simplest means for the accomplishment of the widest ends. The source for expenditure chiefly lies in the addition to the premium for the risk of death which I have explained, and its wise utilization reveals, or fails to reveal, the power of management of the actuary. The most ill-equipped administrator can obtain whatever amount of business he desires by sufficiently lavish disbursement, but one of the critical differences between actuary and actuary consists, not merely of native and developed ability of control, but essentially of that steadfast intellectual foresight and moral tenacity which render every article of expenditure deliberately subservient to the creation of financial benefit to the persons whose interests he holds in inviolable trust—benefit first, in the formation of impregnable reserves, and, next, in the periodical distribution of increasing realised profits. The expenses of a company are predominantly attributable to the acquisition of new business. I have ascertained, from an examination of the Board of Trade returns, that, even limiting the survey to offices which transact a steady and moderate, though adequate, business, the commission and expenses in respect of each year's acquisition is 83 per cent. of the premiums received upon that accession. And, as an aid in the discriminative criticism of the expense-ratios of companies, I have further ascertained, by the analysis of the several

companies' accounts, that the cost, as we should expect, is a function of the average amount of the new policies secured; so that where the assurances obtained consist mainly of policies of upwards of £900, the expense is nearly 22 per cent. less than that connected with new policies which, on the average, do not exceed £300 each. Regarding then the initial cost of new business, which I have thus deduced from the official returns—the normal charge, we might almost term it—for companies which do not inordinately and improvidently covet extravagant figures, what must be the wasteful encroachment upon the new premium income where the most prodigal efforts are squandered to attract needlessly-augmented numbers of fresh members! For excessive additions to the constituency of a company furnish in no sense an index of correspondingly remunerative acquisitions to the policy-holders. We all tend to a failing in favour of mere magnitude; forgetful frequently of the unquestionable truth that vast volumes of business are not necessarily an indication of equivalently increased profits—very generally, the reverse. For complete misapprehension and delusion are at once produced if we measure the extent of fresh accessions in insurance by considerations which appertain to ordinary commercial trade. In trading, it is often asserted, and justly so, that the profit upon each article, in some branches is so infinitesimal, that were it not for an enormous multiplicity of transactions the business would need to be abandoned. The vital difference between the two cases is this—that every new policy acquired requires a cash reserve to be immediately formed as a provision for its ultimate payment. And my practical conclusion is that the present mania for extravagant figures, as the subject of (really baseless) laudation in the annual reports, will surely find its Nemesis—as, in some instances, retribution has already arrived—in a diminution of surplus, and a consequent restriction of the genuine interests of the policy-holders, whose position and prospects should be the supremest care. If the members secured each year be sufficient to ensure the integrity of average results in experience,—and this adequacy is imperative for the maintenance of a continuing corporation,—all excursions beyond that protective and remunerative limit,—fluctuating in its range, I admit,—are not ultimately beneficial. This judgment affords no ground for supineness in energy of enterprise or alacrity of resource: it simply embodies the obvious doctrine,—whose failure of observance in any department of commercial activity signifies ill-success,—that expenditure in the minutest as in the widest mode should be governed not by the desire for excessive magnitude, but by the effort to produce the amplest profit and financial strength, and thus adequately to redeem the recognised trust for others which an assurance company implicitly accepts. The motive, or, more justly described, the imperative duty of an actuary should, by vigilant supervision over every element of administration, aim at leaving his company in a stabler and more prosperous condition on his retirement, or death, than that which he found existing when he assumed command.

(3.) The third, and most productive source of profit is the realisation of a clear rate of interest in excess of the rate on which the premiums and valuations are based. And in the company, whose experience I have already cited, it was ascertained that the percentage of the profit from this margin of interest amounted to 54 per cent. of the aggregate surplus during a period of 20 years. If, as is customarily the case, the rate of interest involved in the valuation be 3 per cent., and if a net uniform rate of $3\frac{3}{4}$ per cent. be obtained upon the invested and uninvested funds, the balance of $\frac{3}{4}$ per cent. per annum represents, at compound interest, the most important contribution to surplus, realised as it is upon the accumulated assets and the annual income. Thus, if we assume an average fund of £4,000,000, and a revenue of £400,000, a minimum yearly profit of £33,000 results from the surplus per-centage alone to which I have just alluded. A word may be interposed upon the unjust incidence of the present mode of assessment of the income-tax upon life assurance companies. This tax is levied at the source upon the entire interest received: interest being an essential factor in the payment of the sums assured, so far, then, as the tax is exacted (as it inequitably is) upon that portion of the interest which is equivalent to the valuation rate, so far is the tax deducted from principal and not from income. The significance of this element of interest suggests a brief reference to the equipment of the actuary and the duty of directors. In former years the actuary was essentially a mathematician: investments were generally restricted to British Government securities as a symbol of respectability, and to mortgages on land; and the stockbroker rendered the actuary

needless in the former department. In modern years any enlarged knowledge of mathematics —though, in my judgment, no actuary possesses that dominant scope and concentration of mind who is not a cultivator of the higher branches of this science—is not imperative beyond a sound and comprehensive grasp of mathematics generally; and the actuary discovers his specialised function in the capacity of commercial administration and signally in practised and sagacious mastery of finance.

The actuary in those anterior times was to a large extent a student, constructing the mathematical science of assurance and solving the problems in life contingencies which its expansion evolved; now he misses completely his destined vocation unless he is practically familiar with commercial transactions and causes, and equipped with that tact and happy judgment in business which are only possible through personal and observant contact with events and men. For, unfortunately, exceptional mathematical aptitude and acumen in affairs not infrequently exist in inverse ratio. The difficulty annually increases in securing appropriate and remunerative investments, and yet upon this pivot turns the future bonus - power of all the companies. This difficulty is occasioned by three or more causes —(1) the competition of the accumulated and augmenting funds of the various offices themselves, (2) the incursion of the general investing public into classes of securities which formerly were virtually restricted to corporations and to bodies possessed of vast resources, and (3) the gradual narrowing of the natural sources of materials and profitable cultivation as civilisation has advanced and the unexplored regions of the earth have successively been developed by capital and skill. But difficulties of investment should simply inspire directors and actuaries with keener powers of survey and wider though cautious enterprise. Experience has demonstrated that British Government securities — the finest the world has ever known — are totally unsuited to life offices, on account of the constantly fluctuating value of the principal and the inadequate return. International relations are now so intricate and complicated, and national intercourse so instant, that a mere breath of rumour in a previously unknown or neglected portion of the world is frequently sufficient to propagate a financial storm at home, and national funds, as the index of national sensitiveness, now respond with instantaneous vibrations. It is not within my province to express any preference for particular forms of investment, or to indicate what I conceive to be the appropriate modes of utilisation for the accumulations of companies. I confine myself to two observations: (1) The necessity of preserving a reasonable proportion between the different classes of investments which a company selects, so that if depression occur in one section of security, and thus deplete the fund, a simultaneous increase of value may be attached to others, and thus afford a counterpoise. During the recent severe depreciation in the values of stocks quoted on the Exchange, some companies felt compelled to write-off considerable amounts, or to divert from surplus a specific fund for possible losses; and this unhappy course would, to a large extent, have been rendered needless had the wise criterion of financial administration which I have expressed been thoughtfully observed, and a sagacious distribution of the assets been arranged in varied forms of investment not so liable to violent oscillations of value as those which are constantly and immediately marketable on the Exchange. (2) My second observation applies to the judicious widening of the customary scope of securities. The debentures of selected and stable industrial companies are worthy of attention; advances upon personal security (in conjunction with life policies) are remunerative when conducted on a definite plan under obvious conditions, and well deserving the constant care and supervision which they entail; while mortgages and investments abroad and in the colonies afford in many instances a sound and profitable range of securities where preliminary enquiry is devoted to taxation, the registration of titles, and the ownership of properties (in the event of foreclosure) by alien mortgagees. For we must remember that the directors of assurance companies are not restricted by the narrow boundaries and circumscribed authority of ordinary trustees. Their powers of investment are practically unconfined, and so should be their prevision and financial energy. Indeed, the mere existence of participating policy - holders furnishes demonstration that an integral portion of the duties of directors is to extend their excursions beyond the customary and monotonous limits of investment for the purpose of providing the amplest bonuses consistent with the discretionary caution which a wise and prudent man of business would exercise in his private affairs. Let me explode

also another empty and pretentious bubble whose flimsiness of texture is often mistaken for solidity of mass. The dictum of high interest signifying inferior security is one of those thoughtless aphorisms which mutilate the integrity of truth for the purpose of presenting a compact and impressive formula. It is a platitude which deceives men by its vagueness; a simulated truth whose reality is largely false. Postulating knowledge and circumspect sagacity, no danger exists in an unusual return of interest. The margin above the current rate will be frequently explained by the principle of supply and demand, or by the fitting supremacy of financial ability over duller and more commonplace wits, and a portion of the excess beyond the average return may be utilised as a sinking fund in redemption of part of the principal during the currency of the investment.

It may here be remarked, though the observation is one of mere speculative curiosity, that life assurance on the basis of the probabilities of life alone would still be practicable were money to cease earning interest. A simple calculation shows that if this contingency occurred our present scales of premium would only require to be increased by 1 per cent. upon the sum assured at every age to secure the payment of the claims precisely and punctually as they are provided at present. Profit, of course, would be absent, as its main origin would then have disappeared; the policy-holders would need to be charged independently for the expenses of management; while the reserves requisite as a guarantee for the fulfilment of the obligations would require to be most substantially enhanced.

In a direct manner I have adverted but slightly to other descriptions of insurance—Fire, Marine, and Accident.. The doctrine of probabilities certainly applies to the calculation of their premiums, though it may be predicted that the scientific processes which regulate the business of life assurance are not fully competent of adoption. For example, in those regions of insurance, we are confronted with the perplexity of partial and total losses, while every claim in life assurance must appertain to the latter category; and again, in fire insurance, in the classification of risks, and the consequent computation of premiums, the elements enter of the local supply of water, the facilities of means of extinction, and the contiguity of hazardous premises. The latter factor, it will be observed, corresponds to those cases in life assurance, where an applicant is, as it it termed, "rated-up" for inferior health or dangerous occupation, which remove him from the class of average lives. And in marine insurance, we perceive also the elements of salvage, particular and general average, the course of trade, with the seasonal and local influences of sky and sea, the record of the captain and the character of the builder of the vessel. The latter reference suggests the remark that, in every form of insurance—including life, the constituent of moral hazard is indiscriminately involved. We note also that fire and marine contracts are of a temporary nature, and include the power, on each side, of refusal to renew; thus doubly distinguishing them from life assurance engagements where this option resides only with the assured. Another distinctive feature is the fact that interest does not enter as an integral factor into the calculation of the rates and the reserve for unexpired risks. Still, there remains with all obvious differences, the fundamental fact, with other similarities, that premiums in these descriptions of insurance ultimately rest upon the ratio between receipts and claims, in other words, upon the determination of the probabilities of risk. If, for example, in fire insurance the current rate of commission and expenses be 35 per cent. of the premiums, and the required profit, 10 per cent., the year's losses in any particular category of risk should obviously fail to exceed 55 per cent; if then, on the examination of the combined statistics of several companies, it is ascertained that the rate of loss has proved to be 10 per cent. in excess of the expected 55 per cent. provisionally charged, it is clear that, upon the basis of this actual experience, the rates must be increased by 10 per cent. in order to equate the total charge upon the company with the relevant receipts. A closer approach to the scientific procedure of life assurance would consist in the comparison of the sums insured at risk, and the amounts which had become claims, but the introduction of this form of proportion would practically be difficult. I have referred to the addition to the premiums for profit, and on this subject I may mention that the chairman of one of our principal fire companies recently stated that, surveying the period of 10 years, from 1893 to 1903, the aggregate fire offices had realised an average annual return of 6¼ per cent. upon the combined consideration which they had received for the enormous risks which the

united capitals had sustained. This result finally disposes of the popular delusion that fire insurance is almost a fabled province of wealth. My next practical remark is that the recent disaster at San Francisco points to two important conditions of management: (1) the accumulation of fire funds in a higher proportion with a view to the prevention of sudden and extensive declensions in the market-values of the shares, and the maintenance of an equalisation of dividends (or, this suggestion may be embodied in the form of a specific conflagration fund which was urged and adopted by a former far-seeing fire underwriter); and (2) the judicious and inviolable observance, against the solicitations of competition, of a wise distribution of the proportionate amounts of risks both as regards nature and locality, in order to avoid an undue concentration of liability in any direction.

The developments of life assurance are generally in only a slight degree guided by the will, or preferences, or originality of the actuaries, but depend upon the changes of popular fashion and predilection, frequently unaccountable and obscure in their origin. I will direct your attention to a selection of some of the modes in which the popular fancy in modern times has found expression.

The major portion of practically every company's new business now consists of endowment assurances. I imagine that the discussion of old-age pensions has contributed to this extreme diversion of choice in the direction of this form of policy, since, in this mode, a pension in advanced age is obtained by the investment of the sum assured in securities, and a pension, also, in the negative shape of the relief from premiums. I do not conceive it to be a satisfactory substitute for the ancient practice of ordinary assurances payable at death. There exists, on the part of the policy-holders, the chance of the amount becoming subject to diminution in consequence of injudiciously selected securities, and the family provision being accordingly defeated, and, on the part of the companies—to the detriment again of the policy-holders—the difficulty and enhanced cost of obtaining business, particularly under the augmented stress of competition which will undoubtedly result, in order to replenish these serious successive abstractions of constituents. The old practice of the payment at death could be accompanied by the cessation in subsequent life of the burden of premiums by effecting the policy with the abrogation of premiums after the age of 60 or 65. I might notice here, in connection with endowment assurances, the provision commonly allowed, that, instead of accepting the sum assured on maturity, the policy-holder should receive an annuity equivalent to 5 per cent. (for example) upon the amount, with the ultimate receipt of the principal at death. I have no objection to urge to any of these modifications or schemes if they satisfy the public, but, of course, it should be clearly understood that so high a rate of interest as 5 per cent. cannot be manufactured by magic, and that, for example, if the valuation rate be 3 per cent., the additional 2 per cent. is contributed by the policy-holder himself in the form of an addition included in his premium.

Assessment companies, as they are termed, have, in modern times, disastrously occupied public attention. As this subject has assumed a prominent importance in America and some currency in this country, a few words of explanation will not be superfluous. In the early years of life the chance of dying in a year is comparatively small, but it increases annually with the advance of age. For example, at age 20 the probability of death occurring in one year is about 4 in 1,000, while at age 60 the corresponding chance is about 29 in 1,000, or about seven times greater; so that, omitting the consideration of expenses, the burden upon the policy-holder at those respective ages for the premium for one year's assurance of £1,000 is £3 18s. 5d. and £28 0s. 7d. In ordinary life assurance, as I have pointed out, those successive annual values of the liability under the contract are added together and the sum divided by an equalising annuity-value so as to ensure a uniform premium throughout life. The policy-holder accordingly knows year by year the precise sum he is required to discharge, and is freed from the possibility of augmentation. This uniform premium is too high in relation to the reduced probability of death at the early ages; but at the older ages it is not sufficient to meet the increased yearly risk; this ulterior deficiency, however, is balanced and compensated by the excesses of premium in the prior years being accumulated at interest (under the name of "Reserves"), and preserved intact, so that the integrity of the necessary provision is maintained without any advance in the rate of contribution. In the assessment system—to consider only its essential principle without the subsidiary details—the assured is required to provide each year the financial value of the risk for that year alone. Thus, in

the prior stages of life he pays considerably less than the policy-holder in an ordinary company, but as life proceeds and the chance of death increases the annual demands upon him continuously exceed the uniform premium. Let me submit an illustration with the exclusion, for clearness, of the element of cost. A person aged 30 assures for £1,000 on the ordinary plan, and his uniform premium for life is £17 18s. On the assessment scheme he would pay at age 30 for the ensuing year the premium of £5 15s. 6d., or 68 per cent. less than that required in the customary mode. But when he reaches the age of 60 the premium for the succeeding year is necessarily augmented to £28 0s. 7d., or 57 per cent. in excess of the uniform charge of £17 18s.; while on the attainment of age 70 the premium exacted for the next year's assurance would be £60 5s. 10d., or nearly 237 per cent. beyond the invariable rate. In the uniform system, as I have remarked, the excesses in the anterior years of the constant contribution beyond the rate applicable to particular years are retained in hand with their accumulation at interest, and thus supplement completely and exactly the annual deficiencies at the advanced ages, in the form of what is technically termed the Reserve. What is the obvious result of the assessment scheme? In the early years the policy-holder exults in his diminished burden, but as these annual payments necessarily increase with the augmented incidence of claims, the vigorous lives tend to desert the office in order to escape this successively intensified charge; sound and youthful lives are restrained from entering to restore the balance and reduce the average age; the weaker lives remain by reason of the difficulty or impossibility of assurance elsewhere in consequence of their deteriorated eligibility for acceptance; and the ruin of the company, with the defeated hopes of its members, are the inevitable issue.

We have been presented, too, with a system which dispenses with a medical examination at entry. But in all commercial transactions, as in the transformations of the forces of nature, no benefit can be secured without an exchange of corresponding value; and this plan is necessarily and justly attended by the condition that if death occur during the first year, the sum assured is reduced by two-thirds, or the amount payable is only £33 6s. 8d. per £100 assured; if the claim happen in the course of the second year a deduction is exacted of one-third, or £66 13s. 4d. is paid per £100 assured; while it is only if death be deferred to the third, or any subsequent year that the complete amount of the contract is discharged. Regarding the subject generally, policies of this nature do not satisfy the intentions of the assured. The most imperative necessity for a family-fund naturally exists in the early years of the assured's life when, if he died—having possessed insufficient time to accumulate any extraneous fund—the provision for the family, after the prescribed deduction, would be most seriously depleted. And yet the abatement is perfectly fair, for the chances of an undetected and speedily fatal disease—such as an aneurism or latent organic defect of the heart—must, in justice to the remaining policy-holders, be counteracted by adequate compensation.

The specialisation of risks is sometimes attempted, and notably in the formation of a scale of diminished premiums for teetotalers, accompanied by the exclusive division among themselves of the profits which their class produces. In the first place, no statistics have ever proved that teetotalism in comparison with moderate drinking is in itself the sole factor in the prolonged longevity which teetotalers as a body enjoy; a deduction of this character involves the fallacy of attributing to one selected cause a result which is really the product of several causes in combination. Teetotalers as a class do exhibit a longer existence than the average, but this consequence is due to the union of self-regarding qualities, thrift, industry, prudential care, which usually distinguish this body, and of which general character teetotalism is merely an indication and embodiment in *one* particular direction and form. There can be no objection but an advantage in teetotalers, if they please, combining themselves in one society of assurance, but there are difficulties of equity, I would point out, in those customary cases where in the same company teetotalers constitute one section of the assured, while moderate drinkers are relegated to a separate division. The assurance fund in these instances is an undivided, indivisible unity, formed indiscriminately by the contributions of both sections. Assume, then, that the teetotalers exclusively obtain the profit derived from their own premiums, in which segregated profits the ordinary section does not participate, are the teetotalers also in equity entitled to rely upon the aggregate common fund—which has been created equally by the

contributions of the moderate drinkers as their own—as a security for the payment of teetotal claims? If they separate themselves from the ordinary section in respect of one department of the common business—the production and distribution of profits—can they claim in justice that the entire fund, which is partly constructed by the moderate section's premiums, should form a general protection for their own particular claims at death? An assurance company, in my judgment, should be constituted a genuine commonwealth, all sharing proportionately the benefits and risks in a common trust, without disruption into sections, or attempted discrimination of privileged preferences.

I advert for a moment to Industrial assurance, which has attained so prominent a position in the general system. The social benefits of this appeal to the people are, from a national point of view, conspicuously manifest. The subjective habit of thrift cannot be arbitrarily manufactured; it must be evolved and developed by the stern teachings of life, the privations and punishments which attend improvidence; but in former years a distinct obstacle to the cultivation of financial prudence, consisted largely in the absence of assurance companies to whom the 1d. or 2d. per week of the provident poor could be committed. With the provision of sound channels for the investment of small premiums, which industrial companies now present, the practical realisation of habits of saving is possible. An objection which formerly existed has now happily been removed by the leading company. These smaller members previously received no portion of the profits which their weekly payments had substantially aided to create, and for a period this course was defensible, since industrial assurance was then passing through the experimental stage; but in quite recent times this unsatisfactory restriction—now that these offices have finally and successfully emerged from the trial, and with their enormous area of experience, stand completely secure — has beneficially been abolished, so that the fullest inducement is at present afforded for the advantageous cultivation of provident practices among the poor.

I have not dealt, from exigencies of time, with the question of the insolvency, winding-up, and extinction of companies; and, happily, the honourable history, on the whole, of life assurance enterprise in this country has removed this subject from practical discussion. In former days, starting with 1844, such a statement would have required a distinct qualification, but those disastrous times have merged into a more prosperous, conscientious, and worthy record. But I cannot refrain from expressing a judgment upon the subject of amalgamations and transfers of companies. In some unfortunate instances this course may conceivably be expedient or imperative for the protection or prosperity of the policy-holders—attributable, for example, to excessive and wasteful expenditure (for no life company has ever been seriously affected by abnormal mortality among its members), or occasioned by inefficiency of administration which, for some inherent reason, may be incompetent of reformation by the company itself. But many amalgamations and transfers are absolutely needless and injurious, and I am glad to observe public indications that the process is likely to receive a decisive check. They possess when they are unnecessary and indefensible—and most of them belong to this category—the following defects:—(1) they curtail the area of public choice in the selection for assurance; (2) they tend to create the bane of monopolies in a branch of commerce of supreme national import, with a consequent diminution of healthy competition in supplying most advantageously the varied public needs; and (3) the difficulty may occur that companies competent of success from their moderate size, and under a management which is able to devote effective attention to every element of organisation and enterprise, may not prove so prosperous when, by amalgamations and transfers, they attain a colossal magnitude which no single mind can adequately control and guide. Devolution of government, of course, is wise, but a limit is reached when devolution may prove inefficient in beneficial supervision.

To pass to a final remark upon the relation of assurance companies to the State, I would add that any attempt at supervision by Government beyond the boundaries prescribed by the Act of 1870 would, in my judgment, be disastrous. So long as companies are permitted to exercise unfettered their powers of responsible enterprise and administration; so long as the public are enabled, by the publication of returns to Government of essential information, to frame a sound estimate of the companies' position and technical provisions; all that is requisite in an enlightened and practical system of commerce and industry has been accomplished, and any transgression beyond these limits would not simply restrain individual and corporate origination and ex-

pansion to the permanent detriment of the public, but would undoubtedly also in principle entail upon the Government the gratuitous and utterly obnoxious financial responsibiliity for any misadventures, deficiencies, or catastrophes that might unhappily occur.

I conclude with a deserved eulogy upon the history of British Insurance which, in all departments of its enterprise and responsibilty, has earned our national pride for sagacity of adminstration and the honourable accomplishment of its trust.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said he did so as an ordinary member of the public and not as an expert or one in any way specially acquainted with insurance matters. He had been particularly struck with the fact that the author advocated that the commercial element should be diminished, and that the trust element should be increased. The insurance man if he did his duty was really in the position of a trustee. In all professions that element of trust should, at any rate, enter, and an organised profession usually had an etiquette and a code of its own. He might suggest in connection with the author's closing remarks, a difficulty which it seemed to him was always present, namely, that the ordinary insuring public could not estimate the relative value of the companies. Many men doubtless sought advice from those whom they thought knew, but practically a large proportion of the public was at the mercy of their own half information. Therefore it did seem to him to be of enormous importance that the training and organisation of the profession of insurance men should be on a par with that of the other professions. His only connection with insurance was that in his daily work he was brought into contact with colleagues who were specially engaged in giving teaching to insurance men. At the present time there was a proposal under consideration for the formation of an Insurance Institute for London, and in connection with it for further provision of insurance teaching. As a teacher he ventured to suggest that it was necessary to draw a distinction between what he might call the training of the private and the training of the general in any profession. There had been in this country a good deal of talk about technical education, but it had usually referred to the technical education of the privates of industry and commerce, not of the generals. He thought the problem of insurance training must be considered in two sections, first of all, the training of the privates, such as clerks and fire-insurance surveyors or the clerks of life-insurance companies. Such people obviously required the power of accurate statement. The general manager of one of the great accident insurance companies told him, a short time ago, that he required a large number of young men who possessed the power of expressing accurately just what they saw, and no more. He replied that he thought a demand was being made for one of the finest flowers of education, not always possessed by University graduates. In the next place, there was the education of the general, or what the author referred to as the administering actuary. In regard to life insurance here we had the Institute of Actuaries, but in regard to other departments of insurance much remained to be done. Various elements had to be taken into consideration in that regard. As he listened to the author it seemed to him there was practically no knowledge which would come amiss to a general in the profession of insurance; in other words, the very highest training obtainable was desirable, both general and professional. In giving that higher education a very special difficulty was involved. Too often the highly skilled mathematician lacked that knowledge of the world which was essential to the complete man of affairs. He ventured to suggest that sometimes they went the wrong way to work in the matter. It was not necessary that all the education should be given during the period of boyhood. It seemed to him that, during that period, a good general education might be given, after which a knowledge of the routine of the profession was required; and until it had been ascertained whether a young man had the aptitude for affairs, was it really worth while to seek to give him the higher training which was desired? What was required in this country, it seemed to him, was the man of affairs who possessed that very special knowledge, which so frequently seemed to incapacitate him as a man of affairs. Now this, he suggested, could be obtained in the way the army obtained it, *i.e.*, by the Staff College method. A period of army routine is interposed between school and college, so as to develope the practical sense. That practical sense was what the business man required, and what he missed so frequently in the University graduate. When that had been developed, the man should be sent, as in the Army, to the Staff College, if he showed those special powers which fitted him to be a general. At the present time insurance companies were asking their young men to equip themselves with that higher knowledge by evening work. The greatest credit was due to all young students who devoted time in the evening, after the day's work, to giving themselves increased knowledge; but he submitted to those who were responsible for the conduct of these great companies that a fair chance was not being given to the ablest young men, the leaders of the future, if they were compelled to obtain their knowledge in such manner. Not only were their brains tired by the day's work, but an hour was not long enough to lift them away from the narrow outlook of the office. Not only physical tiredness but

mental outlook was involved. It was impossible for a student to throw off the office the moment he arrived in a class-room and set to work on the the whole theory of his subject. Mr. Young's remark with regard to the rare quality of attaining by the simplest means the widest ends surely referred to the qualities of imagination and trained skill combined. If an artist, with a few strokes, produced a telling portrait, he did so by the joint use of high skill and imagination; and if a general, by a few movements, produced an entire change in the position of a war, he did it by his skill in discerning the position, and then his imagination gave him the idea which just fitted the situation and enabled him to attain the result. He suggested that there was a similar art of administration. As a rule it might be said that their administrators now arrived by accident. They were men who, by one chance or another, rose early, and blundered into the art of administration by experience. At the present time, affairs were becoming more complicated, and the competition of other countries had to be considered, and it seemed to him a thousand pities that all the experience available should go to waste, and have to be re-acquired by each man. He suggested there was a quicker way of making a man an administrator than starting him as the office boy, and that the key to administration, if the man once had the expert knowledge and the practical sense that came from business experience, lay in habitually nursing ideas, which ideas came from a broad outlook on to the world and on to the profession. The habit of entertaining those ideas came of a higher education. One branch of insurance, the life department, had been highly organised, but the other branches had not, and were now being considered by the calling generally. He submitted, not as one having experience of insurance companies, but as one who had some experience in education, especially education in connection with affairs, that a distinction must be made between the early stage through which all entrants to the calling ought to pass, and the later stage which he thought could only be imperfectly dealt with in evening classes. Those who had acquired the practical sense and were obviously destined for promotion, should have a little breathing space given to them away from routine for the purpose of looking at those great problems of ethics, mathematics, common politics, and of the world generally which had been exemplified in Mr. Young's paper.

Mr. A. H. BAILY thought sufficient emphasis had not been laid on the fact that the life department of insurance companies was already highly organised, and actuarial science placed on a scientific footing. The actuary of a life insurance company had to deal with many branches of finance, such as the granting of annuities, the investment of funds in proper securities, and all kinds of mathematical problems. He did not think the author had sufficiently discriminated between the life offices and the fire offices. For instance, in the one there was a contract of insurance, and in the other a contract of assurance. In fire companies the insurance policy was a contract of indemnity, but in life insurance the contract was an assurance of a specific sum to be paid at death generally. Two totally different contracts were involved, based on totally different principles.

Mr. F. R. SELLER said that, as essentially a fire man and not a life man, he had been particularly interested in the way in which the author compared the life and fire departments by dividing them up into their various branches or divisions, in the case of life with regard to the nature of the trade in which the particular man insured was working, and in the case of fire to the different hazards and risks. With regard to the question of education, to which the Chairman had drawn attention, the actuaries of life insurance companies had for many years past adopted courses of education, and had studied the cases they obtained in their ordinary every-day work; but in the fire companies those facilities had not till lately been obtainable. Fire officers had had to pick up their work in a very great measure at places away from the office. For instance, a fire insurance surveyor's work was quite different from the ordinary orthodox surveyor's. He ought to have the surveyor's knowledge of the methods of measuring buildings, the methods of heating, and the provisions of the Building Acts, but he could not obtain such information at the insurance company's office. The new Insurance Federation had provided such information in the last year or two in London, and he looked forward in the hope that that Federation would supply the needs of the fire-insurance officials in the way that the Institute of Actuaries supplied the life-assurance officials. Several classes were now being held which the officials of the companies could attend. The Chairman's suggestion that the offices should allow men time during official hours to go to lectures or classes would be very beneficial if it were possible to carry it out, but with the keen competition that at present existed he could not see how that plan could be adopted. He could not help feeling, however, that evening lectures were very useful indeed, not only to members of the fire department but to those of the life department as well.

Mr. A. D. BESANT said he had listened with great interest to the Chairman's suggestion with regard to the possibility of giving the coming leaders in insurance companies a sort of vacation, or holiday, from their official duties in order to perfect their knowledge. The keynote of the whole subject was that a young man in an office had to make his living, which was provided for him by the managers, who paid his salary. There was not in insurance companies, as at the Bar and in other professions, a sort of leisured class, who had a certain amount of time during which they could be students, and students alone. Nearly all the young men in insurance

companies had to enter an office to begin with. If they went to the University first, and entered an office at the age of 21 or 22 it was generalfy found that, to put it colloquially, they were too big for their boots; and it was found that the best men for the coming managers were those who had gone through the whole mill. In saying that he did not at all desire to disparage what the Chairman had stated, because if it were possible to pick out the man whom the manager looked on as his natural successor and give him the opportunity, an ideal state of affairs would be obtained, which, if it could be carried out, would be the most effective means of training a company could well devise for its future managers. From the point of view of a Manager, the work of an office depended so much on the members of the staff, as a whole, that one could no more take away his best assistant in times of stress than keep the place open for him for six months, when someone else, to a great extent, would have filled the position which he had occupied up to that point. He was especially glad to notice the importance which Mr. Young had attached to the question of expenses, which in the present day had attracted the widest possible attention. He did not think, however, it had always been considered on a fundamental basis. There were some expenses which were justifiable, and other expenses for mere expansion which were not. Those in the former category were expenses connected with supervision, the investigation of all sorts of questions connected with lives, by means of which bigger mortality profits might, he thought, be obtained than some offices had gained in the past. In other words, it was worth while to spend two or five guineas more in medical expenses if by so doing an early claim could be avoided. The company would gain in the long run, by spending a little more money, bigger mortality profits; and although nominally the expenses, simply considered as a percentage of the income, might be a little high, the surplus and bonus would be so much higher that they would make up for it. Another point of enormous importance to which the author had referred was the question of the size of an office as compared with supervision. He thought the author would agree with him when he stated that a moderate sized office was the best for all parties. In the first place, it was best for the supervision, because one man at the top could control the whole business in essentials although not of course in details; he could watch individual cases and investments, and put his finger on any weak spot in the organisation. In a big office he did not think that was possible, because although the greatest possible genius might be at the top he had to depend on other people who were less gifted. From that point of view he thought Mr. Young's remarks with regard to amalgamations were of the utmost importance. The mania of the moment seemed to be that the usefulness of a middle-sized office was a thing of the past, and that all the eggs should be placed in one basket, a few monster companies being formed which would control the whole market. He did not believe that, in the long run, it would be found that the policy was for the benefit of the offices, the shareholders, or the policy-holders.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Young for his instructive paper, thought it was extremely valuable to the public generally that the ripe experience of professional men like Mr. Young should be put in such a form as to be understood by the people. Those directly interested in insurance owed Mr. Young a debt of gratitude for coming forward and putting before the public the very high ideal he had set forth.

The resolution of thanks was put and carried unanimously.

Mr. YOUNG, in reply, desired to express his grateful acknowledgments to the audience for the manner in which they had listened to his remarks, which were the outcome of forty years of professional experience, and which, especially in relation to the disastrous manner in which insurance was now being conducted, in the way of reckless expenditure and equally reckless amalgamations, which involved expenditure to the serious detriment of the policy-holders, were inspired with the utmost earnestness and seriousness.

GOLD MINING IN AUSTRALASIA.

Since the first discovery in 1851 of gold in Australasia, nearly 140,000,000 ounces of gold have been produced in the various States, over one-half of which was furnished by Victoria. Prior to 1898 Victoria was almost invariably the leading gold-producing State of the group, but in 1904 its yield was about 60,400 ounces less than in Queensland and 1,522,000 ounces less than in Western Australia, which has in recent years increased its production by leaps and bounds from 110,000 ounces in 1893 to more than two and a third million ounces in 1904. In Western Australia, prior to 1898, the entire gold production amounted in value to approximately £5,000,000, but in that year work was begun in earnest with the result that in the succeeding twelve months over £4,000,000 was taken out. In 1901 the value of the production of the gold mines was £6,700,000, in 1902 £7,600,000, in 1903 £8,300,000, in 1904 £8,429,000, in 1905 £7,800,000. For several years the problem of a water supply for the goldfields was most difficult to solve, for about four hundred miles from Perth, the capital of the State of Western Australia, there are no rivers, few natural supplies of surface water, and the rainfall is light. The vital importance of overcoming this difficulty was recognised by the State, and some idea of the magnitude of the undertaking may be formed by the cost of the construction which amounted to over £3,000,000. In

1896 the Premier of the State obtained the approval of the Legislature to an expenditure of £2,500,000 for the provision of a supply of 5,000,000 gallons of water a day. The work was energetically pushed on, and brought to a successful completion in 1903. The supply, which is now regarded as adequate to the demands of the gold fields, is pumped 351 miles. Fully 18,000 men are engaged in mining, and the wages paid are sufficiently high to induce first-class miners to remain permanently employed. In the goldfields the value of mining machinery in use amounts approximately to £4,000,000, and there have been erected about 4,000 stamps. These figures show conclusively the splendid industry that has been built up, and all conditions now point to a continuance of the prosperous conditions.

Victoria, among the eastern States, still holds its prestige as the chief producer of gold in these States. The bulk of the yield in 1905 was, according to the "Mineral Industry in the United States and other Countries," contributed by the Bendigo field, and although the output was less by about 33,000 ounces than that of 1904—which was the highest for the previous thirty years—still it was such as to furnish unmistable evidence of the richness and permanence of the reefs. In the New Chum Railway and the Victoria quartz mines, the existence of reefs carrying gold at the depths of 4,230 feet and 4,090 feet respectively, was demonstrated during the year. The aggregate returns from the Ballarat district varied little from those of the preceding year. The yields from the mines at Walhalla and Beringa show that the industry has made headway in these centres. The total value of the gold produced in Victoria in 1905 amounted to £3,217,000, as compared with £3,296,000 in 1904. In Queensland, gold deposits have contributed more than any circumstance to the rapid advancement of that State, the value of the total output of this metal to the end of 1905, from the first record being, according to official returns, £1,955,000; and the estimated value of the machinery at present employed in connection with the gold and mineral fields of the State in working the mines and reducing the ore, £1,935,000. A geological survey of the State has enabled the auriferous districts to be mapped out. They cover a considerable area in Queensland amounting to about 32,000 square miles. The leading gold districts are Chartered Towers, Gympie, and Mount Morgan. The gold production of Queensland has been steadily progressive, while per head of the population engaged in winning gold Queensland produces more than double that of Victoria, and more than three times that of New South Wales and New Zealand. The value of the gold yield in 1904 was £2,715,000, and the production for 1905 is estimated at £2,550,000. In New South Wales there are twelve gold mining districts—Bathurst, Mudgee, Tambaroora and Turon, Lachlan, Tumut and Adelong, Southern Hunter and Macleay, Peel and Uralla, New England, Clarence and Richmond, Cobar and Albert. The amount of gold produced in the State to the end of 1905 is estimated at 12,532,651 ounces fine, valued at £53,235,000. The production of gold during 1905 was valued at £1,165,000, as compared with £1,146,109 in the preceding year—an increase of £18,904. The gold obtained by the dredges during the year 1905 amounted to 32,038 ounces fine, valued at £136,090 —an increase of £12,434 on that of the previous year. The gold yield for the first nine months of 1906 was valued at £832,066, compared with £804,043 for the same period of 1905, thus showing an increase of £28,023. As in preceding years, the Cobar field in 1905 contributed much the largest output of gold, the yield being 54,237 ounces. The Mount Boppy Gold Mine still further augmented its output during the year. The Wyalong Field ranks next in importance. Other divisions which contributed satisfactory yields were Araluen, Wellington, Forbes, Stuart Town, Adelong, Orange, Peak Hill, and Sofala. Although the gold yield of Tasmania is small as compared with the other Australian States, it shows good progress. The production in 1904 was 65,921 ounces, valued at £280,000, and in 1905 67,897 ounces, with a value of £290,000. In South Australia the yield of gold is lower than in Tasmania, the quantity produced in 1904 being 34,079 ounces only. The natural mineral resources of New Zealand are very great, and have exercised in the past a most important influence on the development and progress of the colony. Gold to the value of £67,231,000 was, according to the New Zealand Registrar-General, obtained prior to the 31st December, 1905, the value of the production in 1905 having been £2,094,000. In the earliest years the gold was obtained from alluvial diggings, but at the present time the greatest quantity is taken from gold-bearing quartz, which is distributed widely through several parts of the colony, and thus there is much better prospect of the permanency of this industry than alluvial diggings alone could give. Of the gold entered for exportation during the year ended March 31st, 1906—viz., 526,000 ounces, representing a value of £2,118,000—about 55 per cent. came out of quartz mines, but if the total yield of gold obtained in the colony be taken, the value of which to March 31st, 1906, is £67,754,000, about 25 per cent. came from quartz mines and 75 per cent. from alluvial workings. Gold dredging in New Zealand is now firmly established as an industry, and in Otago and Southland it maintains a high degree of efficiency and gold-producing results. In Otago 95 dredges were employed all the year round in 1905, and 50 in Southland. The Electric Company's No. 1 dredge's return of 1,273 ounces for five days' actual dredging in 1904 still remains the record of gold won for one week's dredging in New Zealand. On the West coast of the Middle Island the value of gold won was £103,277 by forty dredges. The total number of gold miners employed in 1905 was 9,362, as against 10,898 for the previous year. In some places, more

especially in Otago, Nelson, and on the West coast, many of the miners do not depend entirely on mining, but employ a part of their time in farming and other pursuits. The total value of the gold production of Australasia to the end of the year 1904 is stated to be £512,208,000.

THE COMMERCIAL IMPORTANCE OF ZANZIBAR.

The island of Zanzibar has been under British protection since 1890. It is the great storehouse and distributing centre for trade of the whole East African coast, although with the development of the resources of the mainland, and increased shipping facilities of the several mainland ports, its relative commercial importance is not so great as in former years. The islands of Zanzibar and Pemba (to the north) constitute the principal portions of the domain of the Sultan of Zanzibar. Zanzibar is the larger. It is of coral origin, about fifty miles in length and twenty miles in width, with low-lying hills and fertile valleys. These two islands produce about 90 per cent. of the clove crop of the entire world, in addition to large quantities of copra from the great number of cocoanut palms grown there. The native population, estimated at from 200,000 to 300,000, has made no material advance in the past half century towards taking up European customs, and are, as a mass, afflicted with the indolence found among native tribes generally. The white population does not exceed 500, mostly civil and military officials of the British Government and their families, the representatives of foreign Governments accredited to the Sultan of Zanzibar, and the representatives of those foreign houses having branches there, engaged in foreign trade. The natives are employed for the most part on the clove shambas or farms, the cocoanut groves, in preparing the copra for market, in fishing, loading and discharging ship's cargoes, and on public works. The local business is in the hands of Indian traders and shopkeepers. Household and domestic positions are filled by Goanese, and some few natives.

It is not as a producing centre that Zanzibar takes its commercial importance, but rather from its geographical relation to the Continent of Africa, to the Indian and Arabian coasts, and to the fine harbour on which is situated the town of Zanzibar. In a recent report by a special agent of the United States Government, on the importance of Zanzibar as a distributing point, it is stated that the islands of Zanzibar and Pemba form a natural breakwater between the African coast and the monsoons which sweep over the Indian Ocean, and the harbour has presented for centuries an ideal base for the exchange of foreign-made commodities for the slaves and native produce, brought in caravans from the interior of Africa to the ports on the mainland, and carried by Indian and Arabian dhows to Zanzibar, and thence to the ports of India and Arabia for distribution to their ultimate destinations. The channels thus formed by the movement of the commerce of the past centuries are difficult of change, and this will only be accomplished through the expenditure of much money and effort. The Uganda Railway of British East Africa has contributed greatly to the diversion to Mombasa of those products which formerly were brought by human carriers from the regions surrounding the great lakes of Central Africa, destined for Zanzibar. The harbour improvements at Kilindini, on Mombasa Island, will offer further inducements for transhipping goods at that point direct to the Uganda Railway, which at present is impossible of accomplishment. The ship subsidies given by the German Government, the development of German East Africa, the improvement of its chief port (Dar-es-Salaam), through the extension of harbour improvements and warehouse facilities, and the extension of the railway now under construction from that port to the interior, will induce a greater annual volume of trade at the last named port at the expense of Zanzibar.

As a distributing port, Zanzibar will, however, undoubtedly retain its supremacy in the East African trade over all others for many years to come, as there is much of the movement of the mainland produce confined necessarily to sailing dhows, which offer cheap transportation, and for the further reason that practically the entire trade with the natives of Africa is in the hands of Indian traders, who obtain their supplies of "trade goods" at Zanzibar from the old-established branches of the Bombay firms in exchange for the produce obtained from the native Africans. The basis of the business operations between themselves, and with the natives, is such as to make it difficult for Europeans or Americans to offer such competition as to make any serious inroad into their control. Consequently, those now striving for a share in this trade find it to their advantage to get into the commercial current, and go with it, rather than in oppositiou thereto. This is strongly evidenced by the practice of Germans of employing and supplying Indian traders with German made goods for the "barter trade" witb the natives in the interior of Africa. Realising its importance the leading houses have established at Zanzibar their principal, and often, only branches, relying on agencies to look after interests in other ports. Notwithstanding the commercial rivalry of other places, Zanzibar has maintained an annual average trade of over £2,000,000, about equally divided between the imports and exports of merchandise. The principal articles of import are building materials, coal, grain, groceries, glue, hides and skins, ivory, live stock, piece goods, rice and rubber. The chief articles of export are beads, cloves, copra, grain, groceries (chiefly in transit to local ports), gum copal, hides and skins, ivory, piece goods (chiefly in transit to mainland ports), rubber and sugar. The largest volume of the import trade is carried on with the United Kingdom, India and German East Africa, and of the export trade, with

these countries and France. In handling the very large transit trade, 212 ocean going steamships, aggregating 427,113 tons, entered the port of Zanzibar in 1905; of these, 59 were British vessels, 24 Austrian, 27 French, 95 German, and 7 of other nations. In addition to these, large numbers of sailing vessels, or dhows, carried various products of the mainland, of India, Arabia, and the islands of the Indian Ocean.

MANGANESE IN INDIA.

A good deal of attention is being bestowed in India on the production of manganese, the development of which betokens a new and flourishing industry. Nine or ten years ago it was not known that there were any deposits worth working. In 1896, however, important discoveries of manganese ore were made in the Vizianagram district of Madras, and a company was formed to work the deposits. Further investigations revealed the existence of the ore in the Central Provinces on the Mahableshwar plateau. Enquiry proved that there was in most countries an unlimited demand for it, and that the Indian product was of high commercial value. With regard to its uses, it is probable that 90 per cent. of the world's output of the ore is utilised in the manufacture of steel and iron. The steel so made is extraordinarily hard and tough, very difficult to work, and on this account is extensively used for many purposes where hardness, toughness, and great power to resist grinding wear are required. For mining drills and mining machinery of all kinds, it is in great demand. It is also required for axes and razors; manganese bronze, silver bronze, and ferro-silicon are other principal uses. One of the Indian journals draws attention to its bye-products, used in the manufacture of chlorine, bromine, bleaching powder, glass decolouriser, Leclanché's cell, preparation of oxygen on a small scale, disinfectants, and a variety of bye-products for colouring, dyeing, and other technical uses.

With regard to its export, manganese ore represents, according to the last Indian Trade Review, 82 per cent. of the value of all exported metals and manufactures thereof, other than hardware, the balance consisting of manufactures of brass, copper and iron. The trade received an enormous impulse from the failure of the Russian supplies (owing to internal disturbances) at Donetz and in the Caucasus. The exports from India thus rose from 180,945 tons in 1904-05, to 316,946 tons in 1905-06, making an increase of 75 per cent, while the value rose by 79 per cent. Mr. Noel-Paton states, that the rise in average value was a good deal greater than these figures would indicate, and that as the price of manganese in Europe has risen by about 50 per cent. there can be no doubt that large profits are at present being made.

In a recent lecture on the subject, Mr. Leigh Fermor, of the Indian Geological Department, draws attention to the following figures of production or exports:—

	Tons.
Russia, 1905	388,231
United States, 1904	383,246
India, 1905	282,334
Brazil, 1905	262,416
Greece, 1904	239,635

The figures of the last named, however, fell in 1905 to 4,645, showing that the mines had either given out or the Indian competition had driven the Greek mineral from the consuming markets. He is of opinion that when certain large deposits of manganese are discovered in Mysore, in the Dharwar and Sahara districts of Bombay, along the east coast and in parts of Chotia Nagpur, are worked, India will stand first as the largest producer of manganese in the world. Chemically the ore is allied to iron, cobalt and nickel, and in its pure metallic state is of grayish-white colour. It is very tough and is capable of cutting both glass and hardened steel, but it does not occur in nature in this pure state, but in combination with some 100 or so of metals. Mr. Fermor laid special stress in his lecture on the great advantages that would accrue from smelting the ore in India instead of increasing the expense by exporting the ore abroad and manufacturing it at a great distance from its place of origin. This the Tata Steel Works about to be established at Sini will do for the ore won in the Central Provinces, and similar works are expected to follow in other parts of India.

TRADE WITH BHUTAN.

The friendly part taken by the Tongsa Penlop, or chief Bhutanese ruler, in our recent negotiations with Tibet has had the effect of drawing attention to the commercial possibilities of Bhutan. Mr. J. C. White, the Political Agent in Sikkim, has several instructive comments to make on this in a recent report. He tells us that rice is the chief product, and that this is exported in large quantities into Tibet and finds its way to Lhasa. Wheat, barley, and buckwheat are grown in the upper valleys. In the eastern part stick lac is largely cultivated, but there is room for much improvement in regard to both quantity and methods. Systematic cultivation would pay, for the lac is in great demand and fetches good prices. In the lower valleys and hills there is an opening for rubber planting, for the *ficus elastica* grows naturally in all the valleys of Bhutan. There minerals are found, such as iron and copper, but it is not yet known whether these exist in paying quantities. There are factories turning out silk and cotton fabrics, especially the former. These factories belong to the chief officials. Bhutanese metal work is good, as may be seen from the gold, silver, and brass filagree on scabbards, teapots, pan boxes, &c. Their swords are made of good steel, highly tempered. The trade of Bhutan with Bengal is at present insignificant, but, as indicated above, there is plenty of room for its expansion.

HOME INDUSTRIES.

The Brewing Industry.—It will be interesting to watch the course of the brewing industry in the current year. It should go some way towards supplying the necessary data to form an opinion as to whether the diminution in the consumption of beer and spirits in the country in recent years is due in large or small measure, or in any measure at all, to the increasing temperance of the people. Since 1899 there has been an actual falling off in the clearances of beer for home consumption of 3½ million barrels, and this notwithstanding the growth in population of about 1 per cent. per annum. The decline in the consumption of beer since 1899 has equalled 10 per cent., and of spirits over 14 per cent. Referring to this remarkable shrinkage in his Budget speech of 1905 the then Chancellor of the Exchequer attributed it to "a wave of sobriety" flowing over the country, and his successor seems to be in agreement with him. If that be the true explanation then the present general and growing prosperity of the United Kingdom will not arrest the decline in the consumption of beer and spirits, but this explanation is contested by authorities equally entitled to respect, and who support the theory that the decline has been temporary and due to necessity. If that theory be the correct one then the present year will see not only a check in the decrease of consumption, which in fact, and as regards beer, has already commenced, but a certain measure of recovery. If this happens there will be considerable justification for the view that increased taxation, consequent upon a wasteful war, by diminishing the spending power of the people, and prejudicially affecting trade, explains the lessened demand for alcoholic liquors, and that the wave of sobriety has little or nothing to do with it. Undoubtedly the experience of the past has shown that in bad times the reduction of expenditure on luxuries is the first step in economy taken, and in this category may be placed the consumption of alcoholic liquors. Probably the truth will be found to be between the two extremes, and that whilst there will be recovery in the consumption of alcoholic liquors, assuming the year to be as prosperous as it promises to be, the recovery will not be quite commensurate with the growth of consumption in other directions, or the growth in the consumption of alcoholic liquors in earlier periods of industrial activity. Be that as it may there is ground for the opinion that the brewery industry has turned the corner. The licensing legislation of 1904 has compelled brewery companies to set aside from their profits certain sums to cover the compensation levied for license extinctions, and it is probable that this year or next further licensing legislation of a drastic character will be introduced, but notwithstanding these adverse points the opinion gains ground that the general prosperity will make 1907 a comparatively good year for the brewing industry.

Brewing Profits.—The popular idea that breweries make enormous profits, even after they have become joint stock companies, is not supported by the facts. In a recent number of the *Statist* it was shown that the net profits earned by 78 companies, with a total capital of £90,000,000, gave a return of 5·9 per cent. This cannot be deemed excessive, for the companies selected were among the soundest in the trade. The average rate on the debenture capital employed was about 4⅛ per cent., the average rate of dividend paid on the preference capital employed was about 4½ per cent., and the average dividend earned on the ordinary capital was a little over 10 per cent., but the average dividend distributed on the ordinary capital was 6¾ per cent. The £90,508,237 total capital was made up of debentures, £41,104,342; preference, £25,860,780; ordinary, £23,543,115. Of course, the average return was largely exceeded in some cases. For example, Nalder and Collyer's Brewery Company have returned 22½ per cent. on their ordinary stock (which, by the way, is only £130,000); Guinness, Son and Co., 22 per cent. (the amount of the ordinary stock being £2,500,000); Bass, Ratcliff, and Gretton, 14 per cent. (the amount of the ordinary stock being £1,360,000); and 26 of the 78 companies have paid 10 percent., or over, but the average was, as stated, 6¾ per cent. Examination will show that, at present prices, their debentures yield from 4½ per cent. to about 8 per cent. But with the probability of increased taxation in some form or another, and the capital difficulties incurred by many of the companies in reckless buying up of public houses, the ordinary shares of brewery companies cannot be considered as a good investment.

Commercial Intelligence.—The announcement of the President of the Board of Trade, made the other day to the Walsall Chamber of Commerce, that it is the intention of the Government to make certain changes in the Consular service, amongst other things to give British firms earlier information of trade doings abroad, has been received with general satisfaction by the mercantile community. "In future," said the President, "the Consuls will have to pass through the Intelligence Department of the Board of Trade, where we have information not merely from all the countries of the world, but where we come in close touch with the Chambers of Commerce, and where we get to know by inquiries what kind of information the traders want to know about, and what is passing abroad. Arrangements too, have been made, that in future all information which it is important for a particular trade of the country to see at once, shall be promptly telegraphed or sent to the Board of Trade, and they will send it along to the Chambers of Commerce." The last change is especially important. News to be of value to the merchant or trader must come to him promptly, and much of it that now comes through the Consular Department is belated. A comparison of German and more especially American methods

with our own shows how much more assistance the Consular service of our chief rivals gives to traders than our own. Under the new conditions, as sketched by the President of the Board of Trade, it may be hoped that this disparity will be lessened. It may be hoped, too, that the President will see his way to suggest to his colleagues the advisability of separating the duties of the commercial agent from those of the political consuls, the latter remaining under the control of the Foreign Office, the former being under the control of the Board of Trade. It must be seldom that the duties of the two offices, widely divergent as they are, can be efficiently performed by the one individual. But even when the proposals of the President of the Board of Trade are carried out, and if they do all that is expected of them, much will remain to be done in the way of obtaining better and fuller information from abroad. The trade of the United Kingdom with the Dominion and Australasia is of great and growing importance, and to some extent the Intelligence Department of the Board of Trade keeps traders acquainted with salient facts, but the information available remains fragmentary and inadequate. Take Canada. Our most formidable, indeed, our only formidable, rival for the trade of Canada is the United States, and American Consuls, and official commercial representatives of the United States in Canada are numerous and active. Canada, being a part of the British Empire, is without British Consuls, and British traders have to depend largely upon the excellent weekly and monthly reports issued by the Dominion Government. It is much the same with Australasia and South Africa. The lack of efficient organisation handicaps the British trader, and it may be hoped that now the Imperial Government is directing its attention to the whole matter, an effort will be made to improve the information supplied to traders as bearing upon colonial wants and opportunities.

Trade and Employment.—Without attempting to give the explanation, it is a remarkable fact that at the present time, when exports are increasing with a rapidity almost unprecedented in our commercial history, our total trade in 1906 having for the first time exceeded a thousand millions, there should be a marked increase in the number of the unemployed and pauperism. Taking the amount paid in wages, and comparing 1900 with 1906, the official figures relating to certain trades show the sum paid in 1906 was nearly four millions less than in 1900. If again the average number of unemployed among trades unionists is taken it will be found that the percentage has risen from 3·52 to 5·22, and it is reasonable to assume that the unemployment among unskilled workmen is larger than among unionists. Assuming, however, that it is no more than the 5·22 of trade unionists it means a large addition to the ranks of the unemployed. And naturally if unemployment has increased pauperism has also increased. In the return of pauperism just issued by the Local Government Board for the year ended Lady-day, 1906, a comparison is made between the years 1899 and last year, which shows that there has been an increase in the amount paid in out-door relief since 1899 of 33 per cent. in the case of London and 22 per cent. elsewhere. The official explanation is that it is due to depression of trade. Probably that is not the whole explanation, that some of the increase is due to less rigidity in the distribution of relief, and it may be that the returns for the year ending Lady-day, 1907, will be more favourable. But when all allowances are made, the figures as to unemployment and pauperism are not what might be expected, having regard to the growth of imports and exports, and suggest uneasy reflections as to our home trade.

The Coal Trade.—The price of coal continues to rise, and not because of any combine, but from legitimate causes. The exceptional demand for coal, from Germany, continues; the increased employment of steam shipping, and the decreased ability of Germany to supply her foreign coaling stations, have quickened the demand upon the British coalfields, whilst at home the industrial consumption has been larger. The result is seen in the rise in prices, which has been great. During the last three months, Cardiff steam coal has risen from 17s. to 20s.; Northumberland steam coal which, in November was 3s. higher than it had been a month or two earlier, now shows a further advance of 2s.; in Scotland the advance has been from 1s. to 2s. per ton above the prices current at the corresponding period of last year; in Lancashire "slack" has become very scarce. And not only is demand exceptionally active, advance in wages is being generally demanded. The Northumberland and Durham miners recently got an advance, but they are demanding another; in the Midlands the demands of the men have been conceded; in Scotland the advance of 3d. a day conceded in December has not prevented a further demand for a similar advance. And so elsewhere. Under these circumstances the public cannot be surprised at the higher prices they have to pay. Whether these prices will be maintained depends in large measure upon whether the export demand continues. Fortunately we are nearing the end of winter, when both household and gas-making consumption will decrease, but the German demand, upon which so much depends, shows no signs of abatement, but rather of increase.

OBITUARY.

LIONEL ROBERT ASHBURNER, C.S.I. — Mr. Ashburner, a member of the Committee of the Indian Section of the Society, died on the 26th January last, at his residence in Gloucester-place, W. He was born in 1827, and entered the Bombay service from

Haileybury College in 1848. He served in the revenue and judicial departments, in Gujerat. When the mutiny broke out he was appointed Police Superintendent of Kaira, with authority to raise a body of horse and foot militia to protect the eastern frontier of Gujerat from the waves of insurrection beating thereon from Central India. He was for a time Collector of Khandesh, a district on the northern edge of Deccan, among the population of which is the race of Bhils, respecting which Captain Barnes's paper was read before the Indian Section on January 24th (see p. 323). Subsequently he was advanced to the position of Commissioner of the Northern Division of Bombay Presidency. Five years later he became revenue member of the local Government under Sir Richard Temple. When Sir Richard returned to England in 1880 he acted as Governor for a period of six weeks pending the arrival of Sir James Fergusson. He retired in 1882, after 36 years of Indian service.

Professor Mendeléeff. — Dmitri Ivanovitch Mendeléeff, LL.D., For.Memb.R.S., the renowned Russian chemist, died on the 2nd inst. of inflammation of the lungs. He was born at Tobolsk, Siberia, on the 7th February, 1834, and received his early education at the Gymnasium of that place, of which his father was Director. In 1866 he became Professor of Chemistry in the University of St. Petersburgh, and shortly after the first edition of his great work, "Principles of Chemistry," was published, and in 1869 he brought his views on the Periodic Law before the Russian Chemical Society. In 1905 the third English translation of his "Principles" was published, which was translated from the seventh Russian edition. In this the author wrote, "In carefully preparing this edition I have not lost sight of the fact that I am hardly likely to publish another, and I have, therefore, in many cases spoken more definitely than formerly."

In 1882 Mendeléeff was awarded the Davy Medal of the Royal Society for his researches on the periodic classification of the elements, and in 1905 he received the Copley Medal, the greatest honour the Royal Society has to bestow. In 1896 he was elected an Honorary Corresponding Member of the Society of Arts.

GENERAL NOTES.

Exhibition of Printing.—It is announced that an International Exhibition of Printing and Fine Arts will be held in Paris from July to October next in the Grand Palais of the Champs Élysées under the authority of the Minister of Public Instruction. The offices of the British Section are at 2, 3 and 4, Cheapside, E.C., where all information about the exhibition can be obtained.

Uruguay.—Since Mr. Consul Kestell-Cornish reported on the harbour works of Monte Video last year considerable progress has been made with the port works. In his review of Uruguayan affairs just published (Cd. 2682), the Consul says that the prolongation of the eastern breakwater has been continued, and was expected to be completed by the end of the year (1906). The channel has been dredged up to a distance of 2,000 metres, giving an average depth of 25 feet. A portion of the centre port is being dredged to a depth of 26 feet, in order to allow of the entrance of the larger mail steamers. The construction of quay walls has been continued, and the greater number of the pillars required for Mole A are now completed. The work of reclaiming the land on the shores of Aguada has been continued, and the wooden mole will soon be open for river steamers. The channel is to be furnished with buoys provisionally until lighted buoys are provided, which are expected to be placed in position in the course of the present year.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

February 13.—"Motor Omnibuses." By Lord Montagu of Beaulieu. A. A. Campbell Swinton will preside.

February 20.—"Cold Storage and Food Supply." By Hal Williams. Sir Edward Montague Nelson, K.C.M.G., will preside.

February 27.—"Modern Typewriters and Accessories." By Arthur E. Morton, Examiner in Typewriting to the Society of Arts.

March 6.—"The Discovery of the South Eastern Coalfield." By Professor W. Boyd Dawkins, D.Sc., F.R.S. The Right Hon. Lord Harris, G.C.S.I., G.C.I.E., will preside.

March 13.—"Mediæval Stained Glass, its Production and Decay." By Noel Heaton, B.Sc.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

February 14.—"The Practical Side of Famine in India." By Sir Frederic S. P. Lely, K.C.I.E., C.S.I., late Chief Commissioner of the Central Provinces. The Right Hon. Lord Curzon of Kedleston, G.C.S.I., G.C.I.E., will preside.

March 14.—"The City of Madras." By Sir James Thomson, K.C.S.I., M.A., late Member of Council, Madras.

May 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By Sir Edward Charles Buck, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

May 30.—"Irrigation Colonies in India." By Laurence Robertson, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. This paper hus been unavoidably postponed from February 19th.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S., "Gold Mining and Gold Production." Three Lectures.

LECTURE III.—FEBRUARY 11.—*Gold Production.*—The crushing of the ore; the stamp mill—The extraction of gold by amalgamation; smelting; chlorination and cyanidation—Reforms in consequence of the tube mill and the filter press—Tube mill *versus* pan—Proposed abolition of the stamp battery—The depth of ores; surface and secondary enrichment—Mining costs and gold mining organization.

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.
February 25; March 4, 11.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Prof. John Walter Gregory, "Gold Mining and Gold Production." (Lecture III.)

Mechanical Engineers, Storey's-gate, Westminster, 8 p.m. (Graduates' Lecture.) Dr. H. S. Hele-Shaw, "Aerial Navigation."

United Service Institution, Whitehall, S.W., 3 p.m. Col. Right Hon. Sir J. W. S. Macdonald, "The Organisation of Power Traction on Roads, for National Defence."

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr Alfred A. Hudson, "The Ventilation of London."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Captain R. Amundsen, "To the North Magnetic Pole and through the North-West Passages."

Medical, 11, Chandos-street, W., 8½ p.m.

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. S. L. Hughes, "Parliament from the Press Gallery."

TUESDAY, FEB. 12...Asiatic, 22, Albemarle-street, W., 4 p.m. Professor E. G. Browne, "Account of Investigations into the History and Literature of the Hurúfí Sect, and its connection with the Bektáshí Order of Dervishes."

Royal Institution, Albemarle-street, W., 3 p.m. Professor W. Stirling, "The Visual Apparatus of Man and Animals." (Lecture I.)

University of London, South Kensington, S.W., 5 p.m. Baron D. Kikuchi, Inaugural Lecture on "Japanese Education."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Colonel R. E. B. Crompton's paper, "Modern Motor Vehicles."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Colonel Sir Donald Robertson, "Some Reflections on Modern India."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Annual Meeting.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, FEB. 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Lord Montagu of Beaulieu, "Motor Omnibuses."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. S. Tuke, "The Selection of Japanese Prints."

United Service Institution, Whitehall, S.W., 3 p.m. Vice-Admiral Sir Charles Campbell, "The Strategical Conditions of the North Sea as Improved by the Edinburgh and Glasgow Canal and Dover and Calais Tube Railway."

THURSDAY, FEB. 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir Frederick S. P. Lely, "The Practical Side of Famine in India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Junior Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Mr. Dion Clayton Calthrop, "The Pageant of History."

London Institution, Finsbury-circus, E.C., 3 p.m. Professor H. E. Armstrong, "Scientific Methods."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. A. Harker, "The Minute Structure of Signeous Rocks and their Significance."

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, FEB. 15...Royal Institution, Albemarle-street, W., 9 p.m. Mr. J. F. Lister, "Foraminifera."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "The Place of Ugliness in Art."

Geological, Burlington-house, W. 3 p.m. Annual Meeting.

Quekett Microscopical Club, 20, Hanover-square, W.C., 8 p.m. Annual Meeting.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. 1. Annual General Meeting. 2. Prof H. C. H. Carpenter and Mr. C. A. Edwards, Eighth Report to the Alloys Research Committee, "The Properties of the Alloys of Aluminium and Copper."

SATURDAY, FEB. 16...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Röntgen, Cathode, and Positive Rays." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, FEBRUARY 20, 8 p.m. (Ordinary Meeting.) HAL WILLIAMS, "The Commercial Application of Refrigeration."

Further details of the Society's meetings will be found at the end of this number.

ALBERT MEDAL.

The Council of the Society of Arts attended at Marlborough House on Friday, the 8th inst., when his Royal Highness the Prince of Wales, President of the Society, presented the Albert Medal to Sir Joseph Wilson Swan, F.R.S., "for the important part he took in the invention of the incandescent electric lamp, and for his invention of the carbon process of photographic printing."

The members of the Council present were:—Sir Steuart Colvin Bayley, K.C.S.I. (Chairman), the Duke of Abercorn, K.G., Sir James Blyth, Bart., Sir William Bousfield, LL.D. Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Mr. W. C. Knight Clowes, Sir William Crookes, F.R.S., Mr. Robert Kaye Gray, Sir John Cameron Lamb, C.B., Sir Philip Magnus, M.P., the Hon. Richard Clere Parsons, Sir Westby Perceval, K.C.M.G., Sir William Preece, K.C.B., F.R.S., Sir Boverton Redwood, D.Sc., Sir Owen Roberts, D.C.L., Mr. Carmichael Thomas, Sir William Hood Treacher, K.C.M.G., Sir John Wolfe-Barry, K.C.B., F.R.S., with Sir Henry Trueman Wood, M.A. (Secretary), and Mr. Henry B. Wheatley (Assistant Secretary).

CANTOR LECTURES.

Professor JOHN WALTER GREGORY, D.Sc., F.R.S., delivered the third and last lecture of his course on "Gold Mining and Gold Production" on Monday evening, 11th inst., the particular subject being Gold Production. The lecturer described the crushing of the ore, the extraction of gold by amalgamation, smelting, chlorination and cyanidation, and then referred to changes in processes and machinery, ending with remarks on mining costs and gold mining organisation.

The CHAIRMAN proposed a vote of thanks to the lecturer, which was carried unanimously.

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, February 14; THE RT. HON. LORD CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., in the chair.

The paper read was "The Practical Side of Famine in India," by SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I.

The paper and report of the discussion will be published in a future number of the *Journal*.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

LIST OF MEMBERS.

The new edition of the List of Members of the Society is now ready and can be obtained by members on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, January 29, 1907; T. G. JACKSON, R.A., in the chair.

The paper read was—

THE ARTISTIC TREATMENT OF THE EXTERIOR OF THE PIANOFORTE.

By WILLIAM DALE, F.S.A.

In dealing with the difficult subject of the art treatment of an object which by common consent is not artistic, I begin by craving your kind indulgence. It is my intention to deal with the subject very largely from an archæological standpoint. I am led to this by the very nature of my studies, which have lain among those keyboard instruments which preceded the pianoforte, and which in form were largely imitated by the early pianofortes. For this reason I am not at all sure that I am the best person you could have asked to read this paper. I am not in sympathy with a good deal of what is called decorative and artistic treatment to-day. I am also not in agreement with those who consider we cannot learn from or take lessons from the past, and that a machine-made thing may be as artistic as anything which is old, and which is admired only because it is old. May I be allowed to quote the opinion of one who, though perhaps not recognised generally as an authority on art, had a true perception of the beautiful and as sound a judgment on this question as any. I refer to the Rt. Hon. W. E. Gladstone.

Addressing an audience of working men at the Agricultural-hall, at a distribution of prizes gained at the National Workmen's Exhibition, Mr. Gladstone said in 1893:—

"There are many who believe that in the case of industrial productions it is a loss of time and pains to think about giving to them a character of beauty. It is this falsehood which we ought, if we can, to tear up by the roots. Let me reply to those who tell us so, that, on the contrary, the whole history of Greek art is a demonstration of the truth of that important and essential principle."

Later on in his address, passing to the subject of architecture, Mr. Gladstone continued:—

"There is this great peculiarity in the remains of early Christian architecture. In these remains beauty is not supplementary and occasional, but uniform and invariable. I am not now speaking of the works which were produced in the later Middle Ages, but of those works which present most of all the character of simplicity as their main characteristic. If you travel in Ireland on no account fail to examine the Glendalough churches. I do not suppose there is one of these churches which is 50 feet long. You might build any one of them for £500. But every line of one of these churches is instinct with beauty which the rudest and even untutored can hardly fail to recognise. There is a circumstance in architecture which terrifies me, and that is the tendency which appears to prevail in modern domestic architecture—I refer to its redundant ornamentation. There are a great number of new buildings in London—I hope I am not treading on any ones toes—with regard to which, if you look at them, you will find that the architect had either a horror or a dread of leaving bare a single square foot of wall. Why do we not wage a war against this excess of ornamentation? Excess of ornamentation is, of all things, the most hostile to a due appreciation of proportion, because it is in proportion to the perception of breadth and beauty and line, and in the adjustment of lines to one another, that the art lies, and in that you will find the hope of attaining high excellence in great works. I will mention to you the case of the exterior of Salisbury Cathedral. The man who wants to know what is beauty in stone—beauty not produced by ornamentation—should visit Salisbury, for there he will see less ornamentation on the exterior of the building than in any Cathedral, and, I believe, in a great many domestic houses in London. But if you want to see what can be done by simple beauty of outline, which is the foundation of all beauty, take a look at the exterior of Salisbury Cathedral. It is a model for all ages and all countries."

I would not have troubled you with this extract if I did not believe it had an important bearing on our subject, and I hope before I have done to be able to show you that the most successful attempt to render the pianoforte a work of art was made by one who was guided by similar principles to those laid down by Mr. Gladstone.

I have said that the modern piano is not an artistic object. The inexorable law of evolution is responsible for this. The square pianos of the eighteenth century were well proportioned, and admitted of some decorative treatment, which, though simple, was often most happy. But as the construction of the square piano improved, to meet the musical requirements of succeeding generations, its size and unwieldiness increased, until it was finally improved off the face of the earth. The grand pianos of the eighteenth century were built so nearly upon the lines of the old harpsichords that you could not tell the difference until you opened them. Early in

the nineteenth century their form began to deteriorate as their interior construction altered. The frame, or stand, with its familiar stretcher was abandoned for legs, and the pedals, instead of being attached to the front legs, were disposed of in a lyre-shaped construction depending from the body of the instrument. As iron bars and iron framing came in, and the tension of the strings largely increased, the case of the piano had to be made increasingly strong. Its elegant proportions vanished, and the legs soon became elephantine in size. A tendency has lately sprung up to revert to the smaller sized grands. But the exigencies of modern compass require the key-board to be wide, and the result is a horizontal instrument almost square. These pianofortes, although called by the endearing titles of "Mignon," "Bijou," and "Baby Grands," are ugly in inverse proportion to the sweetness of the names they bear.

The upright pianoforte is only a little more than a hundred years old. The early ones, which were tall, were known as cabinets and upright grands, often with an imposing cornice on the top, quite architectural in its character, and not unlike a Chippendale bookcase—though generally the appearance was spoiled by a wealth of silk curtain fluted and radiated from the centre.

The popular upright piano, known as the "Cottage," has always been as unpretentious as its humble name indicates. Quite one of the earliest, made by Isaac Hawkins in 1800, was, however, decorated with ormolu, and its folding keyboard made it neat and sightly. Modern attempts to treat the ordinary cottage piano æsthetically seem to result in producing an instrument more eccentric and bizarre than artistic. One, called for some occult reason the "Manxman," has doors, and opens like a kitchen cupboard; another, known as the "Medieval English," has for its leading idea the candlesticks, which shoot straight up from the ground in continuation of the legs.

It is necessary to remind those who design such instruments that to produce a case of such a form that no one would imagine it contained a pianoforte is not treating that instrument artistically.

I am fully aware of the difficulties which beset the path of the pianofore-maker who may be artistically inclined. The public will have iron-framed and powerful sounding instruments, and such require cases of a certain amount of massiveness. Herein largely lies the difficulty of treating them artistically. Yet it is germane to the subject to study carefully and reverently the forms and decoration of the instruments of a bygone age, and to see if it is at all possible to translate into modern practice the principles which guided the manufacturers of those times.

Of all the manufacturers of musical instruments none were more noted than the famous family of the Rückers, of which there were several generations working in Antwerp as harpsichord makers from the middle of the sixteenth century until the closing years of the seventeenth. I dare not linger to describe the sweet silvery tone of these wonderful instruments, several of which I have known and played. In the Rückers' family art and handicraft were allied. They were members of the Guild of St. Luke, the painters' guild, because their instruments were painted. The case was usually black, and not often decorated, but, on opening the top, all was changed. The interior of the lid was filled with some pleasing subject, painted by a master hand. The sounding-board, with its carved rose and trade-mark, was covered with a design of flowers, and the edges of the case appearing above the sound-board were enamelled a lovely red—the despair of modern imitators. When not painted, the lid was inscribed with mottoes. In a volume of the unpublished papers of Peter Paul Rubens, which appeared in 1859, is a letter dated 1638, which passed between the painter, Sir Balthazar Gerbier (then in Brussels) and Sir F. Windebank, private secretary to Charles I. It related to the purchase of a Rückers harpsichord for the King of England. The instrument is described as by Hans Rückers the younger, and painted with the subject of Cupid and Psyche, by Rubens. The price was to be £30, without the painting £15. It was eventually purchased and sent to England, but did not please the king on account of its short compass. On being appealed to, Hans Rückers refused to alter the compass. Many such harpsichords must have found their way to England. It was my privilege in 1879 to see one by Andreas Rückers completely restored. Some 100 years earlier it had been previously restored, and a fresh case of mahogany put to it, but the painting and decoration of the interior were unaltered. The painting of the inside of the top I was able to identify as the work of Van der Meulen. It was brought under the notice of Sir Edward (then Mr.) Burne-Jones, and it was largely

this instrument that inspired his conception of the famous "Orpheus" piano, which, later on, I shall describe.

With the mention of the Ruckers family I may dismiss foreign instruments. The early Italian spinets, it is true, were decorated in various ways, some in embossed leather and some with precious stones, and some with painting. Examples of such can be seen at South Kensington. As, however, these instruments were not placed upon stands, but laid upon the table, they had very little in common with pianofortes, and do not fall within the scope of my paper. The English spinet, first made in England about the middle of the seventeenth century, was derived from the Italian spinet. No decoration was employed upon the case, but the form was so beautiful and well-proportioned that I am bound to refer to it. Pepys, in his Diary, records, in his well-known style, repeated visits to Haward to purchase a spinet, and after it was brought home he next buys a stand for the same. This instrument reached its greatest perfection in the days of Queen Anne. Nothing has ever equalled the form of the spinets made by John and Thomas Hitchcock. The picture which you will presently see is of one which was the favourite instrument of the Princess Amelia, youngest daughter of George III. A kindred instrument to the spinet was the virginal; indeed, spinets were often called such, although it is usual amongst connoisseurs to restrict the term virginal to the oblong or coffer-shaped instrument. One of them, by Liversedge, undoubtedly English and seventeenth century, is the only instance I know of a painted English spinet or virginal. It is the property of Mr. Arthur Hill, F.S.A., and was once Dr. Rimbault's. The painting, somewhat rudely executed, it is said, represents ladies walking in the Mall. The harpsichords made in England, like the spinets, were not ornamented. This is somewhat singular, as both the great makers of the eighteenth century, Kirkman and Shudi, derived their art from the House of Rückers. Their cabinet-work was, however, excellent, and the marqueterie stringing, and veneering in panels was very beautiful. I possess a double harpsichord, made in 1770, when Shudi had just taken Broadwood into partnership, which is so finished, and has in addition long strap hinges of brass, which are a very simple and effective decoration.

The first square pianos made in England between 1760 and 1780, were of simple rectangular form, and placed upon a plain stand. Soon after the latter date they greatly improved in appearance, and for about ten years the homely square piano was worthy to rank as a decorative object. It was placed on what was called a "French frame," that is a stand with tapering legs of Louise Seize pattern. Satin and tulip wood, and that beautiful wood, now so little known, called hare wood, was used for decoration, and some little brass work, which was technically known as furniture, was sparingly added. The space above the keys was used for a name-board. The name itself was inscribed on an oval of satin wood, written or engrossed with a quill pen. To the inlays one maker, Longman and Brodripp, of Cheapside, the forerunner of the firm of Collard, added a charming wreath of sweet peas on either side, painted with considerable skill. The proportions of the instruments were good, and it is probably from their winsome appearance that these old instruments, when they occasionally turn up, are often called spinets. Equal praise may also be given to the early grands, which, up to the close of the eighteenth century, carried on the form of the harpsichord. In fact, being somewhat smaller than the harpsichord, their lines were better, and this was particularly noticeable in the curve of the bent side.

In the year 1880, Sir Edward (then Mr.) Burne-Jones conceived the idea of treating the piano artistically. Here I wish to say that one of his aims was the production of a beautiful curve for the bent side, and it is a recollection which I think I alone retain, that in a quiet room in Golden-square he drew on a large sheet of paper in freehand a curve which he wished to be that of the piano he was designing. On testing this curve subsequently, its proportions were found to be exactly those of the grand pianos made in the last decade of the eighteenth century, by the firm in whose house he was. In searching the old books of Broadwood I have found at this period frequent mention of pianos decorated with medallions, and I have met with one instrument of the kind which has survived. It was dated 1798, and was sold at Christie's only a few years back. The medallions were Wedgwood's, they were sparingly placed round the sides and in the space above the keyboard, and had a charming effect, while the cost of the piano in ordinary cases could not have been greatly enhanced. I say in ordinary cases, because in 1796 Broadwood

had the commission to decorate a piano in this style, which was so remarkable that it deserves more than a passing mention. In February of that year the Spanish Ambassador, staying at Grenier's Hotel, in Jermyn-street, gave the order for a grand pianoforte superbly ornamented in satinwood case, with inlaid work and Wedgwood's and Tassie's medallions, &c. He is called "Le comte de Mopox et de Jarnico," but the entry is headed, "Prince of the Peace," for the piano was for "Don Manuel de Godoy," the handsome guardsman, the favourite of Queen Maria Louisa, whom Charles IV. of Spain raised to the rank of Minister of Foreign Affairs. The year before he had earned the title Prince of the Peace by concluding the treaty of Basle with the French Republic. Two months after his English-made piano reached the shores of Spain, he signed the treaty of San Ildefonso and declared war with England, initiating that series of disasters for his country which culminated at Trafalgar. The piano was not, however, apparently for himself. Sheraton's own design for the instrument, of which more than one copy exists, states that it was presented by Godoy to the Queen of Spain, to whose favour the rapid rise in his fortunes could alone be attributed. The instrument took four months to make, and left England for Bilbao on the 22nd of June. It is described as "a grand pianoforte, 6 octaves C to C, in satinwood case, ornamented with different woods with water-gilt mouldings and Wedgwood's and Tassie's medallions. The Prince of the Peace's arms, chased and gilt in burnished gold. 213 guineas —£223 13s. The Prince's portrait in front, by Taylor, £10 10s." It must, of course, be borne in mind that the relative value of money was then very much higher.

For many years I was familiar with Sheraton's design for this piano, and acquainted with the description of it I have quoted. To-night I am able to show you a photograph of the actual instrument. A few years ago a Parisian dealer in antiquities wrote to a lady in England, whom he knew to be a collector of things rare and curious, that he had a piano covered with medallions made by Broadwood, and dated 1796. It was none other than Godoy's present to the Queen of Spain, and it is now in a London drawing-room. Probably looted from Spain in the Napoleonic wars, it remained unknown, but well cared for during a number of years, most likely in some French chateau, until thrown into the market and purchased by this Parisian dealer. Taking it altogether, it is in splendid preservation. The satinwood has mellowed with age, the keys are unworn, and the medallions perfect. As it stands it is a good illustration of the warfare between the designer who wants to be artistic and the manufacturer who must obey the requirements of a musical instrument. Sheraton designed separate and unconnected legs for the piano. It was at a time when such a thing was not known, but the piano-maker appears to have given in and abolished the frame and stretcher. The pedals, which should have been attached to each front leg of the frame, were made to depend from the body of the piano, and a third pedal, added in the middle, acted upon a pad, which pressed against the sounding-board, producing a sourdine effect. This arrangement spoils the general effect of the lower part, and formed no portion of Sheraton's design. "The Prince's portrait in front, by Taylor," one looks for in vain. Above the key-board, surrounded by beautiful decorated work, is the oval where the maker's name and date were always written. In this case the name is written on the rail covering the dampers, and the oval is covered with a device not well put on. Here I should say was once the "Prince's portrait in front," a miniature, by Alexander Taylor, the miniaturist, for which he received £10 10s.

Alexander Taylor was an occasional exhibitor at the Royal Academy for 20 years, and, curiously enough, the last time he exhibited was 1796. Such a high price being paid, the portrait was most likely taken from life, and if so, the redoubtable Godoy must have been in England in the spring of 1796.

Before passing on to mention any decorated pianos of modern times, I should like to show you upon the screen some of the old instruments to which I have referred, viz.:—A spinet by Charles Haward; a spinet by John Hitchcock; a painted harpsichord; an English harpsichord by Shudi and Broadwood of 1770; a square piano, 1782; a grand piano of 1793; a cottage piano by Hawkins, 1810; the "Prince of Peace" piano of 1796.

In passing from the art of a bygone age to that of modern times, I am met with the difficulty of knowing where to choose. There are no leading piano-makers that have not at some time or other produced what are called art pianofortes, and some are showing such to-day. I fear if I were to attempt to describe them I should certainly omit

some I ought to have mentioned. Moreover, there is another reason why I should leave them alone. In nearly all instances they are the outcome of the taste of some private individual whose means have been unlimited, and shew a wealth of decoration and treatment which, in my humble opinion, it would not be wise to follow even if means permitted. It will be more practical to ask ourselves if the pianoforte attainable by folk of ordinary means cannot be made far more beautiful and artistic than it is.

Before dealing with this, the final part of my subject, I must mention two pianofortes designed by two of the greatest artists of the present generation, and also refer to a pianoforte designed by our chairman in 1892 for Mr. Athelstan Riley, a lantern slide of which I am able to shew you. The wood of the case is mahogany, stained to a very dark green, almost black, affording an excellent ground work for the inlays of various woods, mother-of pearl and tortoise-shell up the top of the lid. The inside of the lid is decorated with Gesso gilt on a red ground — the nearest approach to the "Ruckers'" red I have seen. The black keys are inlaid with ivory, and the fronts of the naturals have the "Hitchcock" device. A minor detail, but an extremely important one, is that the ivory is, with great good taste, not bleached, but left its proper colour. The construction of the stand is novel, and will be best understood from the picture.

In 1878, Sir Lawrence (then Mr.) Alma Tadema had constructed for him a grand piano which was designed by himself, and made after the drawings of Mr. G. E. Fox, F.S.A. It was made in the accepted form of the present day—but the design was Byzantine. The decoration consisted of inlays of mahogany, ebony, tortoise-shell, ivory, and mother of pearl, with carvings of oak and ivory, and the work was carried out by Broadwood. Incorporated in the design was a massive seat, the back of which was painted by the artist. The inside of the lid was lined with parchment, and is now covered with the autographs of famous musicians who have played upon the instrument. Further description is unnecessary, as you will see presently what it was like. It must be regarded as altogether unique, and, like the art of its designer and owner, exceptional in its character and distinction.

Two years after, in 1880, was made the famous "Orpheus" piano, the offspring of the genius of Burne-Jones. As I was intimately connected with the inception of this piano, I am able to state that Burne-Jones was largely influenced by William Morris, and had the support and co-operation of the Faulkners. Boldly reverting to the model of 100 years before, Burne-Jones, as I have already described, designed a curve for the bent side, which was an exact repetition of the older curve, although with a greater sweep, owing to the extension of the front, required by the modern compass. The four-legged frame, with its stretcher, was reproduced, and even the loose board in front of the keys, making the front of the instrument rectangular. Several pianos were made by Broadwood of this form. One was the artist's own, perfectly plain, made entirely of oak, and stained all over by his friend Morris such a bright green colour that no one could say æsthetic colours were always dull. Another made for Mr. Muir Mackenzie was of plain oak, and was decorated all over in Gesso work by Miss Faulkner. The "Orpheus" piano was made for his friend and patron Mr. William Graham, and was painted within and without. Round the sides almost in monochrome is depicted, in circular designs, the story of Orpheus. Drawn first in freehand by the artist, they were copied in by his pupils, and finished by himself. The conception of this old-world story is strikingly original. Orpheus, as he enters Hades, is met with a rush of wind, which one seems almost to feel. As he plays his lyre before Jupiter and Juno and makes his request, the God and Goddess are deeply moved, and strong emotion is visible in their faces. As Orpheus is seen rushing through the mists of the nether world, Eurydice lifts her hand to her ear as she catches the familiar sound of his music; while the triple-headed Cerberus, lithe and serpent-like, forgets to bark, and stands agape. Then, with the precious living burden on his back, Orpheus returns. Anxious to behold the form he loves so well, he half turns, and, conscious that with that act Eurydice begins to slip away, he clutches her garments with fearful earnestness. It is too late, the fatal deed is done, and Eurydice is a pale ghost once more. An oblong panel on the end shews the maidens weeping over her body.

The lid of the piano was sent to the Grange, and painted entirely by the artist. On the top is an angel and a poet and a bold arboreal design, amongst which is a scroll from Dante, a poem on spring from the Vita Nuova. Inside Mother Earth is seated on a heap of

gravel surrounded by her good and bad children—an allegory which may be translated into the concord and discord inseparable and immutable in the musical web.

The sounding-board and ironwork are gilded, and on them are painted rose leaves, which appear blown hither and thither as if the pulsations of sound had stirred them. The owner's motto, "Ne oublie," appears in several places. Through the kindness of the present owner, Mrs. Horner, I am able to show to you several views of this beautiful instrument. I will now throw upon the screen views of some of the pianos to which I have just referred, and will add to them the view of a small modern cottage piano, which is the best in form I have been able to find.

I have already given my reason for not dwelling upon the many decorated pianos produced in modern times. Let me say that, so far as form is concerned, most makers are now producing on their own responsibility a few grand pianos which are designed partly upon the old lines, the angular shape and supporting frame of the square legs being adopted. The cottage piano remains much as it was, and usually turns its back to the public, sheltered behind the curtains with which kindly feminine hands drape its rearward. I venture to think that the small Broadwood shewn upon the screen is an exception, and could without much effort be made a thing of beauty. Upon the question of how to decorate the case, when you have improved the form, I only throw out a few humble suggestions. In the first place let us try to believe that the dazzling surface of French polish is not beautiful. This belief, if it dies at all, will die hard. You have, perhaps, heard of the American girl with whom this question alone weighed, and who pointed to the piano of her choice with the joyous exclamation, "Look, Ma, how it shines!" If anything should enable us to avoid this it is the practice which obtains with some of making a dazzling surface, like carriage varnish—a surface, which, when once chipped or injured, cannot be patched up again. To dull wax polish there can be no objection. There is, however, no surface like that which is left from the finest glasspaper, and if you employ hand-carving—and why not do so—the carvings should be left from the chisel. Quiet inlays of wood have a beautiful effect. Ormolu, if not overdone, is suitable in many cases, and might we not with advantage revert to the plaques and medallions of the eighteenth century? Some makers have already copied the beautiful strap hinges of brass-work, and much more might be done in this direction.

But I feel that the art of painting is most neglected in the piano. We need not wait for a genius like him whose work we have admired to-night to give us the creation of his inventive skill. There is plenty of good work suitable for copying, and there are amongst us students and artists who might employ their talent in this direction usefully and profitably. The panels of the cottage piano might be painted in the way that Angelica Kauffmann painted the panels of cabinets, while the surface of the grand piano offers much scope for such decorative treatment.

Our hope for the future lies in a faithful adherence to the principles of the Society which has done me the honour to ask me to read the paper. Our hope lies in the personal skill, the patience, and the genius of the ordinary handicraftsman, and in the recognition of the truth that the necessary complement to decoration is fine and meritorious workmanship. May the day never come when we shall under-value the work of the human hand, and the charm which skilled and intelligent handicraft always carries. A great artist, if he were reported correctly in the daily paper, said last November:—

"In these days, with the increase of people, we need great repetition of artistic things, and these can be obtained sufficiently only by machinery. A copper vase, which it takes three days for a man to hammer out by hand, is not more artistic than one made by machinery in half a day. The sculptor will one day do much of his work by mechanical aid. Antiquity is largely a matter of dust and varnish. We need not cling to the antique. A Gothic window with little panes reflects only the deficiencies of a past age. They would not have had Gothic windows then if they could have had our windows."

I am thankful to believe that such opinions are not widespread. At Doulton's pottery you may see among all modern appliances the potter seated at his wheel as potters sat thousands of years ago, and creating shapes full of charm and beauty such as only the human hand can make—for nothing has ever taken the place of the human hand at the potter's wheel, and never will. So long as we recognise the principles I uphold, we shall never be in sympathy with ruthless restoration in the realm of architecture, nor believe that the crude and raw figures newly put in the facade of the western front of a famous

cathedral are as good as the old. Insensibly I have wandered in my last words once more into the region of architecture, and the distinguished architect who occupies the chair will, I am sure, be the first to forgive me. In 1896, Dr. Stubbs, Dean of Ely, appealed for funds to restore the exterior of the Lady Chapel of his cathedral. In his letter to *The Times* he used words which are so true, and bear so closely on our subject that I cannot refrain from quoting them, and leaving them with you. He says :—

" There is no intention on the part of the Chapter to attempt a ' restoration ' of the interior of the Chapel. They are well aware that is an impossibility. It is said that Welby Pugin once estimated the probable cost of the restoration of the interior of this chapel, with its marvellous arcade of canopied niches covered with the richest profusion of sculptured work at £100,000. But even the provision of that large sum would not make the work possible. There does not exist probably in Europe to-day an artist in stone who could be trusted to repair this defaced sculpture of Alan de Walsingham's craftsmen. For such an artist we must wait for an age when once more art has become not only the expression of a workman's joy in his work, but also the expression of a man of genius who pours into his art, life, conscience, aud labour, as a sacrificial act of devotion to the King in His beauty."

The following letter from Mr. HALSEY RICARDO, was read by the CHAIRMAN :—

" Unless I have been anticipated by the paper, I wish to put it to the manufacturers of pianofortes whether the time has not now come for them to consider the propriety of constructing *square* grand pianofortes. The present length and shape of the " tail " piano is already found to be a difficulty. A very large number of people, who require a grand piano, and to whom the cottage piano is not a substitute, live in houses, or flats, where the reception-rooms are not big enough to admit a concert-grand mainly on account of its size but partly also on account of its intractable shape. In any room—no matter how large—there are not many places, having due regard to the lighting (by daylight), &c., where the piano can be stood, and in most rooms it is a terrible obstruction. The size of its mouth and the required number of its teeth, make its present width, I take it, an irreducible minimum ; and I observe on the part of manufacturers a kind of agony of effort to shorten its tail in order to make it more accommodating to the restrictions of the room in which it will have to stand. The effect of these efforts is increasingly to disfigure its appearance ; it gets lumpier every day ; it has the size without the handiness of an African elephant and the elegance of a mammoth toad. Is it beyond the wit and ingenuity of the manufacturer to pack the works of a piano into a box say six feet long by three feet six inches wide, with the keyboard, not necessarily in the centre, in the longside? Such a rectangular shape would find a place far more easily amongst the other necessary furniture of the room ; and would, I think, be more easy to treat decoratively.

We have to remember, moreover, that whilst the manufacturer is shortening his tail piano all he knows —the pianist is not now content to play upon it merely with his hands, he also insists on playing upon it with his feet ; and therefore to the length of the piano has to be added the extra encroachment of the mechanical arrangement he affixes to the key-board. Whether all this blaze and riot of sound won't lead us in the near future to get our music by the milder method of the (improved) phonograph, time will perhaps shew : if so we shall recover the 25 per cent. of our drawing-room floor space now arrogated by the ponderous piano, filched from our comfort and devoted to the disfigurement of our rooms ; meanwhile, if no home is to be complete without a piano, let us at least have a presentable tyrant, instead of an awkward monster."

DISCUSSION.

The CHAIRMAN said that Mr. Dale's paper contained many very valuable hints on a subject which commended itself to everyone who was musically inclined, and who felt that too much attention could not be bestowed upon an instrument from which so much pleasure was derived, and that it ought to appeal not only to one sense, but to the other senses as well. The author had commenced his paper with a very sad admission—that, by common consent, the modern piano was not an artistic object. There never, surely, could have been a time, except the present, when anyone talking of such an instrument as the piano would have made such an admission ! It was only at the present time that we were content to shrug our shoulders, and sigh, and give up the thing as hopeless. In the earlier days, from the examples they had seen, pianos, so far from being what Mr. Ricardo called disfigurements and encumbrances to a room, were ornaments, and beautiful pieces of furniture, pleasing to the eye as well as to the ear. In those days it was not necessary to call in an artist from outside to design the cases, for the workmen themselves knew how to make them beautiful. They had traditions as to certain shapes to which they conformed, and that artistic sense which inspired all good workmen, the result being that the instrument was beautiful, and pleasing to all the senses. One great difficulty now-a-days was the enormous width necessitated by the great compass. Anyone who had designed a piano—as he had had the good fortune to be called upon to

do—would know how difficult it was to get a graceful shape when the proportion of the width to the length was so much greater than it used to be in the old days of the harpsichord. One would have thought that the compass which sufficed for Bach, Handel, and Beethoven, would have been enough for all time; but he supposed that great width must be accepted as one of the conditions of the present day; and the designer must necessarily conform his design to the conditions of the thing which he had to make beautiful. Fortunately, the piano — even the worst modern ones — had preserved its old harp shape; indeed, it was nothing but a harp laid on its side and played by mechanical means instead of with the fingers. If, as had been anticipated in Mr. Ricardo's communication, the piano were to grow more and more stumpy—shorter in proportion to its length—it would, perhaps, be better to revert to the square grand. Another suggestion which had occurred to him was to set the grand piano upright. The old square grands had lost their harp shape, but why should not the harp-shaped grand be set tail-end upwards? In a museum at Amsterdam to his surprise he once came across a piano of that form. It was an ordinary grand piano with its toe in the air, finished with a sort of scroll, and played upon by the person sitting facing it, as in the case of the cottage piano. He did not known whether there would be any difficulty in making a grand piano in that form. On that point he should like to hear something from those experts in the trade who were present. He could not understand why all modern pianos were put into those hideous rosewood cases which made such ugly black blots in a room, reminding one of Mrs. Ramsbotham's description of old masters she saw in some foreign gallery—when she said she could not see much in them, but they were very black and shone beautifully! Rosewood cases were certainly a disfigurement to a room, and absorbed a good deal of light. The old mahogany cases of sixty or seventy years ago admitted of much more artistic treatment. He was sure those present had been interested in Mr. Dale's interesting paper; and he hoped there would be some expression of opinion from gentlemen in the trade as to the manufacture of pianos and what could be done with them. He trusted that the paper and the discussion which was about to follow would have the effect of arousing attention to the necessity of making these instruments —as pieces of furniture which could either spoil or adorn a room—not only musical to the ear but also beautiful to the eye.

Mr. GEORGE ROSE (Broadwood's) being called upon, said, that as the Chairman had appealed to pianoforte makers, he would attempt to answer one or two points that had been raised. Mr. Dale had asked, Why is the pianoforte externally the thing we see it? The simple answer to that was that the pianoforte was what the makers found they were able to sell. If the pianoforte maker were to work upon the lines Mr. Dale had suggested, he would be utterly unable to pay his way. In saying that he only wished to lead up to what, he thought, was fairly obvious, and which throughout his life he had found to be true, that any advance or improvement in the decoration or artistic beauty of articles of everyday use, must come from those who gradually formed the taste of the nation. If in some respects we had advanced in our ideas of what was the proper thing upon early Victorian days, it was solely on account of the work, and the constant thought and care of those, who, like the Chairman, had led the ideas of the nation in the proper road. It was very difficult indeed for the manufacturers to carry out the ideas which Mr. Dale and the Chairman had so ably put before them. If their clients could only be educated, the manufacturers would be only too glad to make what they knew to be things of beauty. It was some years since the Chairman had designed the instrument which had been shown upon the screen, and which, in his opinion—with all dne respect to Sheraton—was a far more beautiful object than the design of that very eminent cabinetmaker who, especially in the later part of his career, quite frequently went very wrong in some of his designs. It was strange that the instrument Mr. Jackson had designed, which had been exhibited on many occasions, and was known to so many in London, had absolutely never been copied. The reason, surely, was not far to seek. Though we were constantly talking about education in art, as in other things, the public were not yet able to appreciate always what was really beautiful. It was no use asking why the piano was always made of rosewood, and polished like a boot. It was simply because the public wanted it, and would not buy if it were made of anything else. All his life he had had befor him the beautiful examples Mr. Dale had shown, and many others, yet he had found it impossible to get the ordinary customer to accept them. There is a discerning class of people, but the ordinary client would say,—"Yes, it is very nice, indeed," but would pass good design by. One direction in which improvement might well be made was in that of simplicity. Personally he thought the proportions and the lines of a pianoforte were more important than any other attribute of the design. If the Chairman and other eminent architects would only from time to time—as some of them had done—turn their attention to the decoration of that much-abused article of every-day use, the pianoforte, we should, doubtless, in time arrive at something more beautiful. An improvement had, indeed, already taken place in the taste of the public, and it had become possible, recently, to use better and simpler designs for stock models. The design last shown by Mr. Dale, as a good modern example, was produced by the eminent decorator, Mr. Charles C. Allom, for his own use, some years ago, and is, to-day, being largely used and often copied. With regard to the questions as to the shape of the grand pianoforte, and the suggestion

that it might be made vertical, the idea might, doubtless, be carried out, for the clavicitherium, or upright spinet, a very rare instrument, was of this form. As to reviving the square piano, Mr. C. R. Ashbee had designed one a short time ago, and had one in hand for a client at the present time. As the Chairman had said, the pianoforte is a recumbent harp, and that is the reason it naturally takes the form we usually see. With regard to the Sheraton design he ventured to differ from Mr. Dale as to the legs. In many instances of Sheraton's work there was much to lead one to believe that those bulky legs were really his own design, although not to the original drawing. In conclusion, unless it were done with the greatest care it would not be wise to sprinkle the modern piano all over with medallions as Sheraton had done.

Mr. H. H. STATHAM desired to emphasise a point which the author had not forgotten—that the pianoforte was, in the first instance, a musical instrument; but he felt a little jealous, sometimes, of the idea of making it too much a vehicle for ornament, which he thought should be subservient to its original use. He spoke as a musical man as well as one interested in art. When a friend asked him to try a piano, he ran his fingers over the key-board, and if it was satisfactory he did not at the moment think much of the design. The highly-ornamented old stringed instruments to be seen at South Kensington were very incomplete, and very little music could be got from them; but when one came to Stradivarius and Amati, it would be seen that their violins were of the best possible shape for the production of the required sound, and there was but a very severe ornament and nothing else. Such instruments, he maintained, were works of art; they had the beauty of fitness, such as he thought should be aimed at in the main in the case of the piano. There might be exceptional instances where one was inclined to spend a large sum in making a piano a specially beautiful object; but in general what had to be looked to in the making of a piano, as Mr. Rose suggested, was the shape, which arose naturally out of the construction. Mr. Dale was quite right in his references to architecture. What was wanted were fine mouldings and right proportions for expressing construction. The greatest care should be taken in inserting anything, in the shape of added ornament, which at all checked the vibrating power of the instrument. Personally he should be very shy of putting porcelain plaques, or anything of that sort, into a piano; and he rather took fright at the large brass strap hinges, referred to by the author, which, he thought, might rather tend to spoil the tone of the piano. The material which was wanted to surround the strings was that wood which most harmonised with and reinforced the sound. He did not understand why the author objected to the modern position of the pedals, namely in the middle of the instrument. That, surely, was a question of convenience, and was where the player wanted them, and not, as was formerly the case, fixed to the legs. Returning to the square shape of piano, he should have liked to hear something from Mr. Rose as to the length of the strings. If the bass strings were shortened the pitch must be obtained by thickening them, but that would not produce the same tone. To get the finest tone out of a grand long bass strings were necessary. A long-tailed piano, therefore, was really the finest instrument. Short pianos, which were so much disliked on account of their appearance, he objected to on musical grounds, because there was less uniformity and volume of tone. The shape of the grand arose, he thought, naturally out of its construction and, therefore, artistically it was correct. He had seen one of the square pianos designed by Mr. C. R. Ashbee to which Mr. Rose had referred. It was not the old form of square piano with the key-board at the side, but an enormous square thing with the keyboard at one end. It seemed to him a clumsy thing, and calculated to fill up a room much more than the ordinary type of grand piano. He should like to say one word with regard to the key-board. He deprecated any sort of artistic tampering with the black and white keys. One sometimes heard of people with æsthetic tastes having the black keys white and *vice-versâ*, or having inlays on the black keys. But in process of time that might produce a little roughness on the surface of the key which would injure the touch; and the eye also was apt to be misled. Black and white made a very strong contrast, and it was undoubtedly best for the player. It fell in, too, with the principle for which he had been contending—that no ornamentation should be applied which, in any way, interfered with the real use of a pianoforte as a musical instrument.

Mr. HUGH STANNUS, desired to express his thanks to Mr. Dale for his interesting paper. The author, he observed, had spoken of "artistic treatment," and not merely of artistic form, or artistic decoration. The word "treatment" covered both: first, the form of the case, and, secondly, the decoration of that form. People generally seemed to think that a piano was artistically treated when an ugly form was decorated without improving the curves of the lid. Looking at the drawing of the case which had been shown, it would be seen that while the decoration was charming, the curve of the lid—which approached a parabola, was not really a parabola—but exceedingly ugly. As the octaves go down, the strings doubled in length theoretically. It was that doubling, while the distance between the normals remained the same, which produced that most beautiful of all mathematical curves, the parabola, which should be preserved. Then came the decoration of that form, and this opened a very wide field with which it was impossible for him to attempt to deal. Speaking generally, he would like to put a gloss on the word "artistic" as used by Mr. Dale. It meant, he supposed, the

following of certain rules agreed upon by masters of that art. If that were the real definition, it followed that the artistic treatment of a piano-case should be (firstly) suitable to the material, and the material being wood, because of its vibratory qualities, it would obviously be wrong to introduce details which imitated the architecture of stone. The case should (secondly) cover, but not disguise, the mechanism. There were three parts by which the sound was produced, namely, the keys, the hammers, and the strings, and any case, to be artistic, should recognise those three elements. He had never seen a piano which was completely satisafctory in that respect. The case should (thirdly) assist and not impede the tone. Mr. Statham, an amateur musician of admittedly very high capacity, had dealt with that subject, and he need not therefore enter into it. The less metal and the less non-vibratory material put on a piano the better. He had seen piano cases literally overladen with ormulu, which would spoil the tone. Although it might be a very beautiful thing to look at, the piano was, after all, a musical instrument, and not a peg upon which to hang decorative treatment. A fourth point which must not be lost sight of was the fact that the case must permit of accessibility to the working mechanism. A fifth point was that the piano should be constructed so as to occupy as small a space as possible consistent with its use. There were, he thought, great possibilities in the old upright form in which the harp-shape was placed vertically. It might be made so as to give a 10 feet string from floor to ceiling, thereby necessitating very little loading with copper wire in order to get the deep bass, certainly not so much loading as was necessary in the case of the over-strung cottage piano. A sixth point was that no one, so far as he knew, had ever fairly and honestly treated the desk. Too often it was packed away in a dodgy manner, as though one were ashamed of it. Surely the desk was a part of the design, and the artist who had any sympathy with the instrument would take care that it was properly treated. It was those difficulties of treatment which tried the artist, and when difficulties were turned into triumphs, one felt that a true artist was at work on the instrument. Seventhly, he had seen the lights arranged in a most dangerous manner at the corners. The pedals were another point well worthy of consideration. There was plenty of room for improvement in the lid. He regretted the absence of enterprise in the matter of design for cases. After making two piano cases, one of which was thought successful, he felt so strongly that there was an opportunity of further development in the application of scientific principles which had never yet been properly applied to grand pianoforte designs, that he offered to give one of the leading London manufacturers a design for a grand piano to send to an Exhibition which was coming on in the course of a couple of years, but the maker would not accept his offer; and the result was that the design of an American firm was considered the best. Such papers as this one would draw the attention of the public to the question, and there would be hope of improvement.

The CHAIRMAN said he was sure he could speak for all in expressing their thanks to Mr. Dale for the extremely interesting paper which he had read, and also for the illustrations on the screen which they had all so much enjoyed.

The resolution was carried unanimously.

Mr. DALE said he was greatly obliged for the kind expression of thanks which had been accorded him, and also to those gentlemen who had taken part in the discussion and expressed their opinions so freely. At that late hour he could not comment on their remarks in detail, but would merely thank them very heartily for their kind criticisms, and their kind reception of his paper.

TENTH ORDINARY MEETING.

Wednesday, February 13th, 1907; A. A. CAMPBELL SWINTON, M.Inst.C.E., M.I.E.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Foster, Edward, Irwin, Montego Bay P.O., Jamaica, British West Indies.

Gröne, H. Dawson, Inspectorate-General of Customs, Peking, China.

O'Brien, Lieut.-Colonel J., 4, Atherstone-terrace, Gloucester-road, S.W.

Scott, John Gray, Tramways Office, Hong Kong, China.

Sen, Baikunt Nath, Saidabad, Khagra P.O., Murshedabad District, India.

Treble, Mrs. Lillian Massey, Toronto, Canada.

The following candidates were balloted for and duly elected members of the Society:—

Fazl, Shaikh Abul, M.A., LL.D., Jullundher City, Punjab, India.

Green, George Arthur, Public Works Department, Poona, India.

Hanton, Samson Baskcomb, Boys' High School, Rondebosch, Cape Colony, South Africa.

Hartshorne, William Davis, Methuen, Massachussetts, U.S.A.

Hough, Warwick M., 902, Rialto-building, St. Louis, Missouri, U.S.A.

Litten, John George, F.S.A.A., 241, Pitt-street, Sydney, New South Wales, Australia.

Naftel, Cecil Oakley, 20, Eastcheap, E.C.

The paper read was—

MOTOR OMNIBUSES.

By Lord Montagu of Beaulieu.

Less than two years ago the motor omnibus was looked upon as hardly a serious factor in reference to public locomotion. Most traffic experts shook their heads and the chairmen and managers of the great railway companies smiled, when one talked to them about motor omnibus competition, or the linking up of railway stations with outlying country districts by means of mechanically propelled road vehicles as an alternative to building branch or light railways. Two years ago none of the chief omnibus companies of London had any mechanically propelled 'buses running (though a small company were just starting on the Edgware-road route), and a large proportion of their boards and their shareholders were inclined to regard the motor 'bus as an object either not worth serious consideration, or to be avoided and snubbed. Since then to the present moment there has been a rapid and remarkable change of public opinion. Only lately railway chairmen have one after the other complained of the competition of motor cars and motor omnibuses as affecting their receipts, while the tramways of the London County Council and other municipalities, and tubes have shewn by a decrease in the number of passengers carried how quickly and seriously the motor 'bus is acquiring the traffic of the tubes and tramways which hitherto they had considered their monopoly. To quote a specific instance, Sir Henry Oakley recently told the shareholders of the "Twopenny Tube," of which he is Chairman, that he would probably have to alter the present fare and charge 1d. for certain short distances, instead of the universal fare of 2d. hitherto in vogue, in consequence of the competition of motor omnibuses. He added that in the last six months 1,000,000 passengers and £17,000 in receipts had been lost, and this he attributed to the competition of the new means of street locomotion. The chairmen of other tubes have also been telling the same tale, while the perfervid utterances of the tramway advocates of the London County Council show how nervous they have become. It is of course inevitable that they should be jealous and openly abuse the motor 'bus, for it is evident that the profits—if any—of the tramways owned by the London County Council are being seriously threatened by the increase of motor 'buses, which can carry a far greater number of passengers for a smaller capital outlay.

I have no intention or wish, however, this evening to enter into current politics, either national or municipal, but locomotion is rapidly becoming a political, or, at any rate, a municipal topic, and totally to avoid the criticism of tramway specialists and their theories is impossible. The effect of the advent of the motor 'bus in London and in some other large towns has been very marked. The recent returns of the London County Council show that the total receipts declined last year by about £40,000, and the amount paid in relief of rates has diminished from £69,000, the maximum in 1901, to nil in 1906. Moreover, it seems to me the more perfect the motor 'bus becomes—no one would assert that it is in any way perfect yet—and the more its admitted drawbacks, such as noisiness, jerkiness, vibration, aud skidding, are remedied, the more formidable rival it will become to every kind of rail or horse traction. Already motor 'buses in London last year carried 184,000,000 passengers, as against 180,000,000 carried by the London County Council trams. Probably, however, taking a broad view, for the time being at any rate, there will be enough traffic in London and other large towns to occupy all and every possible means of conveyance. But if one considers in the case of London the congested character of many of the principal streets, and the utter want of co-ordination in the design of traffic facilities, it is clear that until a London Traffic Board is established, which will contain experts in every form of locomotion, it will be hopeless to think that public traffic facilities in and around the Metropolis can be properly organised or controlled. It is unfortunate, moreover, that the present Government have not seen their way to carry out the recommendations of the Royal Commission on London Traffic, an entirely non-political body, whose report is recognised to be the most up-to-date document on town traffic in the world, who advised the formation of an independent London Traffic Board. Perhaps we may hazard the conjecture that the political pressure of the so-called Progressive party on the London County Council prevents Ministers carrying out what they know would be right in the interests of London, for tramways have been made the sheet anchor of the Progressist programme. I will not say more as I am beginning to enter upon dangerous controversial ground.

A few statistics as to the number of motor 'buses running in London at the present moment may not be out of place. The average

motor 'bus carries 34 people as against 26 by the horse vehicle. A motor 'bus does the work of 1½ horse 'buses. Therefore, a motor 'bus replaces from 12 to 16½ horses per day, reckoning 11 horses per horse 'bus. As to numbers, on the 1st February, about 850 vehicles were licensed and running, a number which shows an increase of about 300 since the 1st August last. On that date there were something like 800 to 900 new 'buses on order, but a number of these, although now constructed, have been disqualified or put back for alteration by the police licensing authorities at Scotland-yard on account of alleged noise or other defects. The number running would otherwise have well exceeded 1,000 by now. To this subject of examination and licensing I will refer later on. There are at the present time, so far as I have been able to gather, from information kindly supplied to me by the principal companies, about 1,000 ordered or constructed but not yet on the roads.

The capital embarked by the various public conveyance companies in motor 'buses, garages, &c., in London, is just about one million, estimating that the average cost of each 'bus is about £700, of which about £600,000 is represented by vehicles actually running on the streets, while the balance is invested in 'buses on order and buildings. The number of men employed by the various companies, including drivers, mechanics, cleaners, attendants, &c., can be safely estimated at about 4,000.

In the country about another million has been invested and the amount is increasing rapidly. Local services controlled by small companies are becoming more common, and are in some places superseding the country carriers. Existing motor 'bus services in London are conveying about 400,000 passengers daily, and it is a startling fact, which I have mentioned already, that during last year the few motor 'buses actually running, averaging not more than 550 for the complete year, carried more human beings than were carried on the various London County Council tram routes in the same period. The capital cost of the latter has already exceeded £6,000,000 sterling. This is a fact which is self-eloquent as to the superior financial prospects of the motor 'bus, showing as it does that the vast capital expenditure necessitated by old-fashioned systems of railed traction compared unfavourably with the smaller outlay necessitated by the self-propelled and mobile motor 'bus. From another point of view it is interesting to reflect that less than two years ago frothy democrats were denouncing all motor vehicles as the luxuries of the rich, and declaring that they would be of no use to the democracy. But the motor omnibuses which convey in London alone 2,500,000 of passengers per week prove that they were wrong. If we add the country passengers we shall be safe in assuming that over 3,000,000 passengers are carried by the public service vehicles of this kind every week.

As regards the daily average takings of motor and horse 'buses, from some confidential figures which some of the companies have courteously sent me, I estimate that the motor 'bus in London earns from £4 10s. to £6 per day, as against the horse 'bus, which averages £2 10s. to £2 15s. Originally the greater earnings of the former might have been attributed to novelty, but now the motor 'bus is one of the common objects on the streets this argument can no longer hold good. The fact is that the motor 'bus carries more passengers in addition to covering more miles per day, so that its earnings are therefore greater than the horse 'bus.

The average distance covered by motor 'buses in London varies from 90 to 120 miles per day. The longest routes covered by these vehicles include Lewisham to Oxford-street, Putney to Bow-bridge (traversing the City), Charing Cross to Richmond, Putney to Gospel Oak, Tufnell-park to Barnes-common, and others. Motor 'buses are now, or will soon be, running into distant suburbs, such as Epping and Barnet on the east and north, while to the west and south their routes go as far as Richmond. Probably in the near future there will be a regular service to all places within 20 miles of London, and in connection with this it should be remembered that the motor 'bus, unlike the train and tram, can convey the business man, clerk, or artisan, from the pavement near his place of work, or wherever he happens to be, to a point if not actually his home, in most cases the road or end of the street in which he lives. It is this conveyance practically from door to door which is one of the most valuable qualities of the motor 'bus. Here the railway, tramway, and tube are equally at a disadvantage. At the present moment at the busy times of the day, the motor 'bus is consequently so popular that the difficulty is to get a seat at all, and even when the new omnibuses now on order are put on the streets, for a long time to come between the hours of 8 and 10 in the morning, and 5 and

8 in the evening, motor 'buses are likely to be overcrowded.

In the matter of mobility the motor 'bus, too, has another advantage over its fixed rail rival, for if it is not wanted on a particular route in the middle of the day it can ply on other routes which may be more profitable, whereas in the case of tramways the cars must go backwards and forward on the same route, being unable to deviate in the slightest from their railed route. For instance, afternoon runs from the suburbs to shopping centres can be organised. Another merit of the motor 'bus is that it can draw up at the kerb to put down or take up passengers. The centre of a muddy street congested with hurrying traffic is not an ideal spot for joining or alighting from a conveyance. Yet in the majority of cases this is the fate of the tram passenger in big towns.

As to the various makes of 'buses I do not propose to enter very largely into mechanical details to-night, but am glad to be able to say that whereas originally most of the public service motor vehicles employed in Great Britain were of foreign make, the majority of the more successful vehicles now in use have been built by English firms. The two main systems in use at present are the ordinary internal combustion engine worked with petrol, and steam, the former vehicles being the most numerous. Although steam ought theoretically to produce superior flexibility, quietness and ease in manœuvring, in everyday practice it seems to be very little, if at all, superior to the internal combustion engine. As to the future there are some who think that electrically propelled 'buses, operated by means of accumulators, will eventually supersede other systems of propulsion. It seems, however, that the perfect accumulator is as far off as ever, though Mr. Edison, as a rule, announces two or three times a year that the problem of supplying electric power in a smaller compass and with less weight has been solved. But there is no evidence as yet that such an accumulator is approaching the commercial stage. Another system which is about to be tried, and of which I can speak more hopefully, is that which is proposed to be used by the Auto-Mixte Omnibus Company. This is a combination of the petrol engine and electricity, the latter being used chiefly as a means of transmission of power, though a few storage batteries are also carried for certain purposes such as starting and assisting up hills. Some experts think that this system or something like it will eventually become universal. The chief problems of to-day are how to reduce noise, and how to provide for extra power for starting and for sudden short hills. These are the difficulties with which the modern engine, whether steam or petrol, has to cope.

There are many special advantages of the motor 'bus which are clearly admitted even by its opponents. But there is one supreme disadvantage to which I must refer, viz., the tendency to skid on any road which is at all of a slippery nature. Skidding may be said to arise not only from the motor 'bus itself, but to a large extent from the shape of the road, and from horse and other refuse left upon it; also from unscientific construction of the road surface. When mechanically-propelled vehicles become the rule and not the exception, roads will doubtless be made concave instead of convex, the concavity being very slight. But the skidding of motor 'buses largely depends also upon good or bad driving. Many motor 'bus drivers are now so experienced that they can handle their 'buses on almost any surface, whether slippery or not, whereas others do not seem to have the knack of so doing. It should also be added that there are many devices which would appear to prevent skidding entirely, but the regulations of the Local Government Board, which are strictly enforced by the police authorities, prevent their application. For instance, although ordinary horse-drawn traffic is allowed to proceed on iron-rimmed wheels, motor traction, if it exceeds eight miles an hour and weighs over a certain tonnage, must have rubber or resilient wheels of some kind. The fifth wheel remedy is probably the simplest device to prevent skidding, but cannot be made much use of on account of this regulation, for to be of any use the metal sides of the fifth wheel should project outwards, and the tire as presented to the road, should be slightly concave instead of flat or convex.

I have referred to other nuisances of motor 'buses, viz., noise, and I think there only remains the third drawback, namely, smell, which I now believe is hardly worth serious notice in this place as it has been practically abated, and the blue hazy smoke which used to follow behind many of the motor 'buses a year ago is now comparatively rare. Over-lubrication is merely a result of faulty design or faulty working, and just as this nuisance has been eliminated in private cars it can be eliminated in motor 'buses.

One of the drawbacks to motor 'bus traction hitherto has been the running costs compared with other forms of public traction. A year ago it may be said that the average cost in London for each motor omnibus was upwards of 11½d. per mile run. From the information which has been recently supplied to me, most of which is confidential, I can assert that the average cost does not exceed 10½d., while in some cases it is lower, 9¼d. being the lowest figure I have seen.

By the courtesy of my friend, Colonel Crompton, I am able to quote from his pamphlet "Modern Motor Vehicles," the figures which he estimates as the cost of running a motor omnibus in London, and in the country:—

London	10·27d. per mile.
Country	12·94d. ,,

and also to give a very interesting Table (see p. 378).

Now the cost of operating tramways, even on a big scale such as is the case in the London County Council system or that of the London United Tramway Company, has been estimated by experts to average 10d. per mile, so there is little if any difference in the cost per mile at the present time, and critics allege that there is a tendency in the case of tramway accounts to provide an inefficient amount for depreciation. But I would add that whereas tramways in their original horse form were established about 60 years ago, and whereas electric and mechanical trams have already been running some twenty years, motor 'buses have hardly been running on our streets for two years in a practical sense. The most economical methods of running have not yet, therefore, been ascertained, and expenses inseparable from new ventures are being incurred, which leads one to think that in the future the working expenses will be still further reduced. Is there even now any other form of public traction which can show as low a cost as 9¼d. a mile?

One of the most important points to be considered in relation to the successful running of motor omnibuses is the question of the training of drivers. A year ago the majority of men were admittedly unskilled in their work, or if skilled had not given satisfaction, as a rule, in their former situations, and had taken to motor 'bus driving as a temporary means of livelihood. Not only were the majority unskilled in mechanics but also in handling of the vehicle and in proceeding through London traffic, the latter an art in itself, which can only be acquired by practice. No one, however, can help being struck with the great improvement in the driving of the 'buses now as compared with a year ago. I was watching a few days ago, during one of the temporary thaws, followed by brief snow falls, which make the streets of London in winter more difficult to travel on than any other surface in the world—the efforts of a man in charge of a motor 'bus passing below my window in Piccadilly, to overcome the skidding of his vehicle and to proceed on his way. At this particular point, the roadway is constructed in a thoroughly unscientific and dangerous manner, as there is a sharp fall towards the south side of Piccadilly, which I estimate at not less than 1 in 15, and this excessive camber tends to cause all vehicles, even horse 'buses, to skid down towards the pavement, when proceeding westward towards Hyde-park Corner. I must honestly say that a driver of ten years' experience could not have handled his vehicle better than did this man and one or two other drivers who had the same difficulties to face. They were cautious, yet bold, and eventually regained complete control of their vehicles on a surface which could only be likened to a butter slide. In each of the many cases I witnessed on that particular day, I saw not a single collision with a street refuge or with any other vehicle, or even with the kerb, a fact which in itself does great credit to the many drivers concerned. This great improvement is largely due to some of the large companies having taken great pains to train their men, but not a little credit is also due to the diligence and interest of the drivers themselves in their work. Not only is a trained man more safe from the public point of view, but in the long run he is a cheaper man from the motor omnibus company's point of view, although he may receive higher wages. To give you some idea of what I mean, I may mention that at one time a certain large and well-known company could not insure their omnibuses against accident with the insurance companies or at Lloyd's even at as high a premium as £1 5s. per week per 'bus, or £65 per annum for each vehicle. The number of wrecked refuges and pillar-boxes, and of shattered lamp-posts, to say nothing of accidents to other vehicles and human beings, were up to a year ago quite formidable. I dare to prophecy that four or five years hence motor 'buses will not only be rapidly superseding every other kind of public service vehicle, but that they will be looked upon rightly as the safest, and be more

WORKING COST OF MOTOR OMNIBUSES IN LONDON IN SEPTEMBER, 1906.

Average daily mileage	120
Number of days worked per annum	250
Average annual mileage	30,000

	Per annum.	Pence per mile now.	Pence per mile in future.
	£ s d		
Wages—			
Drivers, at 6s. 9d. per shift .. .. / Conductors, at 5s. 8d. per shift	227 10 0	1·820	1·820
Fuel—			
Petrol, $6\frac{1}{2}$ miles per gallon, at $8\frac{1}{2}$d.	163 10 0	1·305	—
Crude paraffin, 5 miles per gallon, at $2\frac{1}{2}$d.	—	—	0·500
Lubricants—			
60 miles per gallon, at 1s. 4d...	33 0 0	0·264	—
360 ,, ,, at 2s. 4d.	—	—	0·078
Tire repairs—			
By contract	234 0 0	1·875	—
,, ,, ...	—	—	1·750
Maintenance—			
By contract	225 0 0	1·800	—
,, ,, ...	—	—	1·400
Depreciation, at 20 per cent.	170 0 0	1·360	1 360
Insurance (fire and third party	50 0 0	0·400	0 400
Car-sheds	100 0 0	0·800	0·800
Cleaning omnibuses	15 0 0	0·120	0·120
Lighting	10 0 0	0·080	0·080
Supervision	50 0 0	0·400	0·400
Cost of licenses	6 0 0	0·048	0 048
	1,284 0 0	10·272	8·756

NOTE.—Column 3 is added to show what would be the cost when items for fuel, lubrication, tire repairs, and maintenance are reduced by improved design.

WORKING COST OF MOTOR OMNIBUSES IN THE COUNTRY IN SEPTEMBER, 1906.

Average daily mileage	80 miles.
Number of days worked per annum	200
Average annual mileage	16,000

Country.	Per annum.	Pence per mile.
	£ s. d.	
Wages, drivers at 40s. per week .. / ,, conductors at 15s. per week	143 0 0	2·145
Fuel, six miles per gallon, at 10d.	111 0 0	1·665
Lubricants (100 miles per gallon at 2s.)	16 0 0	0·240
Tire repairs, at 2d. per mile	134 0 0	2·010
Maintenance and repairs	135 0 0	2·025
Depreciation at 20 per cent.	170 0 0	2·550
Insurance (fire and third party)	50 0 0	0·750
Garage	30 0 0	0·450
Cleaning omnibuses (done by conductor)..	0 0 0	0·000
Lighting	20 0 0	0·300
Supervision (engineering and traffic)..	50 0 0	0·750
Licenses	4 0 0	0·060
	863 0 0	12·945

noiseless than any form of traction we possess at present. This is a big claim to make, but if so much progress has been made in less than two years, what will be made in double that time in future?

As to the wages of the drivers, they naturally vary in London and the provinces, but the average driver earns from 6s. 6d. to 6s. 10d. per day of nine hours, and about the same when paid by the trip, which is now the commoner method.

In future I think we shall see the motor 'bus used in an increased degree for the purposes of excursions from London into the country. Probably in a short time there will be a number of public vehicles which will take London passengers to race meetings, such as those held at Epsom, Hurst-park, and Sandown, and to river-side resorts, and such places as Richmond-park and Epping Forest. On Saturdays and Sundays there will be, perhaps, longer excursions to Brighton and sea-side resorts, thus enabling many thousands to get a breath of fresh air without the trouble of catching trains to and from a railway station, probably some distance from their home. No doubt, also, we shall soon see excursions for two or three days, or for a week or more, organised by the motor 'bus companies from London or other big centres of population to beautiful parts of Wales, Scotland, or the West of England. These excursions would, I believe, even now be well patronised, though of course there is yet no vehicle specially designed for such long distance runs. But the motor 'bus will certainly be ubiquitous and popular long before the main roads are fit to carry much increased fast and heavy traffic of this nature.

To refer to the employment of motor omnibuses by railways, it has always been somewhat of a surprise to me that, with possibly the exception of the Great Western, they have made no attempt to make much use of them.

Those who have endeavoured to develop their districts by their own motor 'buses have suffered far less in diminution of receipts than those who have allowed others to start services, in fact in many cases they have gained in passenger receipts compared with those railways who have declined to move with the times, or who have allowed prejudice to prevent them making use of the new form of conveyance. Perhaps the most notable instance of progress in the right direction has been that of the Great Western Railway, which already has twenty-four distinct services in connection with its system, varying from facilities for such thickly populated districts as Slough, Windsor and the Thames Valley neighbourhood, to services in the far West of England in sparsely populated parts where the motor 'buses have to make long journeys, and so to speak have to work hard for their living.

Nor are the Great Western stopping here. Next summer they are organising fresh services in Wales, and opening up beautiful routes between Cardiff and Aberystwith and other places in that district. Several other railways have also endeavoured to develop their country districts by the addition of motor 'bus services, such as the North Eastern, the Great Northern of Scotland, while in a minor degree the South Western and Great Eastern have in a half-hearted sort of way, and apparently with little energy, been endeavouring to follow in the footsteps of the more progressive railways.

There are many villages and towns of considerable size which lie at some distance from places on main lines, while on many branch lines the service is difficult to arrange so as to fit in conveniently with main line trains, and communication is consequently bad. Probably too if the truth were known there are but few branch lines on our trunk systems which pay as branch lines, and in many cases it would probably be cheaper for the railway companies to tear up the metals on these branch railways and convert them into motor roads, which could be easily prepared for the purpose. They could then run thereon their own motor 'buses, in addition to making a charge for other cars, instead of continuing the present expensive system which necessitates frequent renewals of sleepers and rails, and signals, the maintenance of station platforms and the wages of station-masters, porters, booking-clerks, and all the staff necessary to operate ordinary railway services. But boards of directors are intensely conservative as a rule, and probably neither they nor the general managers realise at present the possibilities of saving money, and at the same time giving better services which may lie ahead of railways in this direction.

There has been some discussion of late as to whether public service vehicles, such as motor omnibuses, should bear any cost beyond the rates which they pay on any real property which they own or occupy, towards the upkeep of the roads over which they travel. This is a question which is bound to come to the front with increasing force. In the case of tramways the companies have to pay rates not

only on their depôts, but on the strip of the street over which their cars run—in some cases amounting to a considerable sum.

In the case of motor 'buses they are exempt, as are all other vehicles not running upon rails, from paying any contribution as vehicles towards the upkeep of the roads. I am not at all sure that this principle can be defended, for it is obvious that those who use the roads should, as a matter of theory, help to pay for them. The present system is founded, however, upon the assumption that only the surrounding owners and occupiers are interested in the upkeep of the roads or derive any advantage from using them. It is conceivable, to take a possible case, that a motor 'bus company might have a depôt well outside the metropolitan area and pay nothing whatever towards the highway rates, and yet have the use of the London streets for the purpose of earning revenue for their shareholders. This can be fairly described as indefensible in principle, and I cannot help thinking that, in the near future, the motor omnibus companies and all other vehicles, including private vehicles, will have to pay something towards the highway rates as vehicles. Of course, as regards public service carriages, it will mean that the public themselves will have to pay towards the upkeep of roads —for the fares will have to be readjusted to bear the burden. But this is only as it should be. At the present moment millions of people are daily using the roads in town and country alike who do not contribute anything towards the highway rate, while others who use the roads but little, and derive but small advantage from them, have to bear nine-tenths of the burden. It should be remembered that Lord Goschen, whose recent death we all regret, brought in a Wheel and Van Tax when he was Chancellor of the Exchequer. The idea was then rejected, as the political pressure brought to bear upon members of the House of Commons by the owners of carts and waggons was such as to make its passage impossible. Public opinion has, however, advanced a good deal since then, and I can only advise motor-omnibus managers and shareholders to see that if an attempt is made to tax their vehicles, other vehicles are included and made also to pay their share, for all should pay for what all use. The motor 'bus can also claim that it does not cause so much wear or tear to streets or roads as many horse-drawn vehicles, the hammering hoofs of the horses being absent. In towns also the absence of the droppings of sixteen horses per 'bus is also a considerable saving in scavenging, besides the gain in cleanliness and public health. As a matter of room, I may mention that a motor 'bus takes up slightly less room than a horse 'bus, a gain to the traffic of the streets.

I think a word or two should be said as to the much-criticised action of the police in disqualifying motor 'buses on the grounds of noise or other defects. In this matter the Commissioner of the Metropolitan Police has been between the devil and the deep sea. On the one side he has had continued protests and petitions from frontagers whose houses abut on the roads, also from shopkeepers, as to the nuisance arising from the motor 'bus traffic— a nuisance which is not only prevalent during the day when the volume of other sounds somewhat diminishes its particular noise, but also at night when the jaded brain worker is seeking repose. On the other hand the Commissioner has been confronted with promises, or at any rate understandings which have been arrived at between the motor 'bus owners and his officials as to types which were considered by them at one time to be perfectly fit to run on the streets. Those who blame Sir Edward Henry should remember that the omnibus which was considered quiet enough to pass Scotland-yard tests last year has not a chance of passing to-day because neither the public nor Parliament would allow it. The motor 'bus proprietors, on the other hand, are declaring that Scotland-yard has broken its promises and has rejected types which were then passed as inoffensive to the ears of Londoners. The question is indeed a difficult one. I know there have been cases of hardship for certain motor 'bus companies, and yet I cannot in another sense blame Sir Edward Henry for the levelling up of his standard — though in some instances I think more notice might have been given to the companies concerned, and that hopes ought not to have been held out originally that certain types would be certainly admitted to run, in view of the uncertainty of the public attitude on this question.

In this connection one of the greatest difficulties arises from the human factor. There is, curiously enough, no machine by which noise can be measured for any prolonged period, for though the gramophone and phonograph will accurately register for a few seconds or minutes certain well-defined sounds, the intensity and volume of noise

has yet to be measured by a scientific instrument. I may mention that at the present time I am occupied with a friend who is assisting me in endeavouring to produce such an apparatus which will be applicable for measuring noises, whether in railways, streets, or anywhere else, where a long and accurate record of noise is required. But the only testing apparatus used to-day for motor 'buses is the ear of the licensing inspector. If this individual happens to have a cold in his head he probably does not notice slight grinding in the gear to anything like the same extent as he would in his normal state of health. If again he has home or official worries, or is suffering from nervous strain of any kind, a noise which in reality may be comparatively small will appear to him large, and jar upon his nerves, probably causing him to disqualify what another and happier inspector possessing better nerves, would pass. It is true that there is an appeal to the Assistant Commissioner and some others, but naturally courts of appeal do not like upsetting the judgment of trusted officials, and it is no wonder that in the majority of cases those appealed to decline to alter a decision already arrived at.

Rapid, cheap and efficient conveyances for the public use, whether in the cities or in the country, are a most important factor in the well-being of a nation. Locomotion enters so largely into the problems of civilised life, and into the development of a nation's prosperity, that I may, therefore, be pardoned if, in conclusion, I depart from the question of mere facts and figures, and ask you to follow me for a moment into a field which is social and political. It is but a truism to say that the great evils arising from congested humanity in cities can be largely solved by cheaper and swifter locomotion. The man working whether with brain or hand, does not nowadays count the distance from his home to his work in miles, but in the minutes taken on the journey. Congested areas and high rents depend, to a large extent, therefore, upon insufficient and slow public locomotion, for they are only crowded on account of the propinquity of the situation to lucrative work. If, say, a clerk in the City could make his home at a spot 20 miles out of London, to which there was a rapid and punctual service of motor 'buses, taking him from his home to his business house in the same time as it now takes to get to either Brixton or Ilford by train and horse 'bus, providing that the new locomotion is equally cheap and punctual, he would tend to go to the new spot where rents would be certainly cheaper, where there was the possibility of a garden, and where the wife and family could enjoy more sun and fresher air.

Crowded areas in towns have arisen not so much on account of the gregarious tendency of mankind, but on account of insufficient traffic facilities. To be close to his work is the aim of every worker. It means not only more time at home in the evening, but also what should not be forgotten, a longer sleep in the morning. At the present moment the time taken to reach the suburbs of London is ridiculous compared with their distance. None of the existing railways, tramways, or tubes, have altered this to any large extent of late for they run on fixed lines, and unless the place of business is close to the one station and home close to the other, much time is wasted, and a house nearer the centre is more desirable.

As regards the country we have exactly opposite conditions to the town. Producers are in this case languishing, because there are no consumers near at hand, while dullness and consequent apathy in every-day life becomes one of the traits of the countryman as compared with the townsman, because the former has to stay always in one place. Communication with the neighbouring large town is often difficult and expensive, and farmers complain that they cannot get their produce to market sufficiently cheaply or quickly, at the same time as the town dweller complains that his perishable foodstuffs are stale and expensive. All these difficulties could be removed by better inter-communication, and mechanically-propelled vehicles at the service of the public, which, running upon the road, could convey food or other necessaries or luxuries from producer to consumer direct, would be both profitable to the owners and would do much to solve many of our land and population problems. Better locomotion must increase the well-being of the race, and motor 'buses can and will do much in this direction.

DISCUSSION.

The CHAIRMAN, in opening the discussion, thought it would be admitted that the most striking figures Lord Montagu had given in his paper were those comparing the London motor omnibuses and the London County Council tramways. The author had put forward a statement which was not exaggerated, in fact, he thought it could have been made even stronger, that at the present time the motor omnibuses of London, with a capital expenditure of about one

million sterling, were carrying a larger number of passengers than the London County Council tramways with an expenditure of six million sterling. He understood it was proposed by the London County Council to spend five millions more. He would suggest that, before those further five millions were expended, due consideration should be given to the possibility that it might be better to save a large portion of that sum and apply the remainder to making improvements, not only in the width and corners of streets, but also more especially to the surface of the roads, thus enabling the motor omnibuses to carry the population more smoothly and with less noise. The author had been kind enough to refer to him in connection with tramway statistics. So far as provincial tramways were concerned he could in many cases give figures that would be reliable; but he confessed that when he came to deal with the figures of the London County Council he should be sorry to express his entire feelings. Of course, it was very easy to show a profit on any business if a great portion of the expenses were charged to other accounts, and that was, he was afraid, what the London County Council did. In May last, Lord Welby, the chairman of the Finance Committee of the London County Council, after admitting that some £40,000 to £50,000 would be required to make up the amount required for renewals in the past two or three years to a standard of 1d. a car mile, which was the then standard of the London County Council, went on further to admit that that sum of 1d. was in itself too low a figure. Moreover, it was interesting to note that the Comptroller of the London County Council, in evidence which he gave officially last year before the Select Committee of the House of Lords, based his estimates on an allowance not of 1d., but on 1½d. per car mile. Thus it would be seen that the London County Council managed to show no loss on their tramways by the simple plan of allowing for renewals a sum which the chairman of their Finance Committee admitted was too small, and which was in fact 33⅓ per cent. less than the figure put forward as a proper one by the Comptroller of the Council. But was even 1½d. sufficient? Turning to Glasgow, whose municipal enterprise was always held up to admiration by the votaries of municipal trading, something startling would be seen, for Glasgow allowed for renewals and depreciation a figure which approximated to 3d. per car mile, just double that put forward by the Comptroller of the County Council. The Glasgow trams had been running for a long time, and they had experience which the London County Council had not, and if, therefore, the figure of 3d. per car mile was allowed, the London County Council's so-called profit of £4,000 a year immediately became a loss of £120,000 a year. Lord Montagu had given some very interesting figures, taken from a paper read by Colonel Crompton at the Institution of Civil Engineers, in regard to the costs of running motor omnibuses in London and the country. So far as London was concerned, he (the speaker) was in somewhat of a difficulty, because there was severe competition. He, therefore, did not wish to say more than that he thought Colonel Crompton's figures were approximately correct. As far as the country was concerned, he happened to be in a somewhat freer condition, because at Bath (where he was a director of the tramway company, which had commenced running motor omnibuses in connection with the tramway) there was no competition, and there was no reason why he should not give the actual figures. Last year the company ran their motor omnibuses, exclusive of depreciation and of general management, but inclusive of everything else, for 8·56d. per car mile. It was an open point what should be allowed for depreciation, but he would assume Colonel Crompton's figure as correct, namely 20 per cent. The reason supervision was excluded from the figure of 8·56d. was simply because the company added the motor 'buses on to the tramways which already existed, and they did not add to their management expenses; but again he would take the figures of Colonel Crompton, ·75d. If those figures were added together, the total cost of running the 'buses was just about 1d. less per mile than the figure given in Colonel Crompton's table; and it must also be borne in mind that Bath was a very hilly district, and the conditions of running were very severe. With regard to the question of the rating of omnibuses, from a strictly legal point of view the rating of any movable object was absurd. Only things attached to property could be rated. It was contrary to all legal ideas to rate movable objects, but motor omnibuses might be taxed, which was another way of getting at the same result. He agreed up to a certain point with the author of the paper, that there were reasons for inquiring why a tramway should have to pay (although it must be borne in mind it did not pay anything upon its rolling stock, which was also the case with railways) and a motor 'bus company should not pay anything. That sounded plausible at first sight, but he would put the matter in another way. Motor omnibuses, as they were at present allowed to run by the Local Government Board, had to be fitted with indiarubber tyres; and, at any rate, so far as asphalte, wood paving, or stone sets were concerned, the 'buses did not wear the roads to any appreciable extent. The road was worn out by vehicles with iron tyres, and by the horses with heavy hoofs, and he thought, therefore, it would be grossly unfair to tax new and modern motor vehicles which did not wear the road, and leave untaxed the older vehicles which did. In fact, he thought himself the proper basis would be to begin by taxing all the vehicles that wore the road; and if that was adopted there would soon be none of the old sort left. He thought, however, it was probable there would be something of the nature of taxes applied to motor vehicles. He would further point out that those vehicles were the carriages, not of the rich, but of the moderately well-to-do and the

poor, and although it might be termed taxing the companies, the people who would eventually pay the cost were the passengers. It was, therefore, a doubtful question whether it would be worth while to go into the question of taxing public vehicles because of the very great difficulties which existed. Unless the continental plan were adopted in London, of a system of gates, complicated by a system of registration, he did not know how the taxes could be levied.

Mr. T. CLARKSON, after congratulating the author on his fresh and suggestive paper upon a vital subject, thought it would be agreed by all that the running of a motor 'bus service was the most severe kind of work to which any motor vehicles could be put, the work of private motor cars and commercial vehicles not bearing any comparison with it. One of the essential difficulties of the problem was the paradoxical nature of the service. In the first place, it was continuous, *i.e.*, the cars had to be in service 18 or 19 hours a day, and in most cases they were not permitted to get cool. Another difficulty was the intermittent character of the service, owing to the large number of stops and starts which had to be made; while another difficulty was the rough treatment the 'buses obtained, the rough roads over which they had to run and, rough garage facilities. In spite of these drawbacks, they were required to give a smooth and silent service free from vibration. The importance of garage facilitities from a financial point of view were not yet sufficiently recognised. Military authorities recognised that, in the late war with Russia, the Japanese owed as much to their medical and hospital equipments in replacing the wounded men early into the field as to the efficiency of their battalions; and it was important to recognise that garages should be made as highly effective as possible in order to put quickly out on the road cars that had been in the wars. At the present time, lubricating oil was not used so effectually as it should be. He knew of some 'buses which used 1½ gallons a day, while others used 2½ gallons, but he saw no reason why a 'bus running under London conditions should not be effectively lubricated with ½ gallon a day. If such a saving were effected, in a service of 100 cars the annual saving would be £3,000. In order to maintain a regular service a certain number of cars must be kept in reserve, in his opinion, one in five or six in London, and one in seven or eight in the country, being sufficient. With a reserve of one in seven, at Torquay, the lost mileage for the first year of service was 3 per cent., for the second year 1 per cent., and the last year ·98 per cent., a record which had not been approached by any other motor 'bus company, either in town or country. With regard to the question of capital outlay, £5,000 was spent on the 'buses at Torquay; and during the three years they had paid dividends of 7½ per cent., and put to reserve a sum equal to half the capital. Unfortunately, however, the 'buses came too late, because a tramway scheme was too far advanced to be abandoned. £80,000 had been spent on the tramways during the last four years, and they had not yet carried a single passenger, while over 1½ million passengers had been carried by the motor 'buses. Although it was quite a small service, the facts he had mentioned emphasised the importance of the financial point. Dealing with the question of steam versus petrol, it must be borne in mind that the thermal efficiency of the internal combustion engine had practically been reached. He had recently been studying Mr. Dugald Clerk's paper, which was shortly to be read before the Institution of Civil Engineers, on the limits of thermal efficiency in the internal combustion engine, and he found there was not much chance of getting a higher mileage per gallon out of the internal combustion engine than was already obtained. By the employment, however, of more highly-superheated steam, under conditions approximate to the internal combustion engine, it was possible to increase the efficiency of the steam engine fully 50 per cent. more than anything at present on the road. The temperature at which steam was now being used, about 700 degrees, was gradually being raised; and he had recently made tests which went to show that none of the steam cars on the road at present were giving as much as 60 per cent. of what would be obtained in the future. Like the North Pole, the perfect motor 'bus had not yet been reached. In addition to the difficulties of the road, difficulties connected with the Scotland Yard authorities had to be faced, which had directly and indirectly involved the pioneers in a blizzard of unprecedented vigour; but he did not think it would be many years before the great superiority of motor 'buses over every form of mechanical traction upon the roads for the work they had to do would be admitted on all hands.

Sir BOVERTON REDWOOD desired to express his high sense of the value of the paper as a contribution to the literature of the subject, and thought the Society was to be congratulated upon having obtained so interesting a paper. The author was well qualified to discuss various aspects of the subject, but in addition he was in the peculiarly fortunate position of being able to speak freely and fearlessly where others equally well-informed might perforce have to remain silent. He hoped in the interests of the ratepayers some of the remarkable statements which had been so graphically set forth would be considered by tramway enthusiasts before further recommendations were made for increased expenditure on that system of locomotion.

Captain SWINTON, L.C.C., after stating that he was not, as he was supposed to be, the great opponent of tramcars in London, and that he had no personal or financial interest in motor 'buses, said he had taken rather a strong view on the subject of the expenditure of the County Council on their tramway system, and the way in which the so-called profits had been put

before the people. He did that with a high sense of responsibility, because he did not believe in those profits. It had already been stated that the County Council did not place a sufficient sum against depreciation and renewals, but he held that what wrecked the figures of the London County Council was the way in which the expenditure on street widenings for tramway purposes was dealt with. The tramways of the London County Council stood in the books of the Council as having had £4,700,000 expended upon them, but, in addition, four millions of money had been spent in widening streets along which the tramways ran. He was prepared to state that, if the tramways had not existed under no circumstances would more than two millions of that money have been spent, and of the remaining two millions up to the present time only £152,000 had been put against the tramway system, while a further £200,000 was to be charged against it, so that the people of London were paying £1,700,000 which they would not have had to pay if there had been no question of running tramways. About a year ago he read a paper before the Society on the question of London Traffic, in which he contended that most of the problems which had to be dealt with in London depended, to a very great extent, on the power of both men and the produce of their labour being carried about London cheaply and quickly. The tramcar had great advantages. When it was going fast and when it was not impeded it was undoubtedly the most comfortable method of travel imaginable, especially to passengers on the top; but from personal experience he had come to the conclusion that, for fast travelling, it was necessary to get on a motor 'bus and not on a tram car. He strongly held that all forms of competition were required in London, in fact, as a ratepayer, he did not think too much competition could exist, as long as it was co-ordinated for the advantage of everybody. If the London County Conncil had had power to run motor omnibuses, it was perfectly certain they would be running them all over London at the present time; but although they started to run 'buses across the bridges, as a part of their municipal trading, they were stopped. If it had not been for that, so much would not have been heard about tram cars; but the controlling body of the moment having embarked on such an enormously costly system of locomotion, they looked upon every other form of traffic as an enemy. In his opinion the principle which should be adopted was that suggested by the London Traffic Commission, which consisted of an extraordinarily able body of men of various political opinions. That Commission unanimously recommended the formation of a Traffic Board, which, however, the Progressive party at Spring-gardens had blocked owing to their jealousy and obstinacy. The only way in which the present state of affairs would be remedied was by the appointment of a Traffic Board, which could look ahead for twenty years, consider the matter in all its bearings, and produce a practical solution for the troublesome problem of the locomotion of London.

Mr. Sidney Straker thought that if motor 'buses were to be allowed to be used as a section of the vehicles in London for public carriage purposes, the Central Traffic authority which at present existed would have to be overhauled. Owing to the heavy restrictions which now existed, unless some revision was undertaken it was obvious that not only would the using companies be a non-existent quantity but the manufacturers as well. At the present time they were in the same position as the Commissioner of Police, namely, between the devil and the deep sea. A car which would be passed by the authorities at the present time would not be passed a month hence, with the consequence that the makers were nonplussed and incapable of designing a vehicle which complied with the requirements of the public authority. At the present time a quarter of a million pounds worth of completed motor 'buses were awaiting licenses from the public authority in London, and it was a crying demand that a central authority of capable and competent men should be appointed. The way also in which the using companies were conducting their respective businesses was causing considerable anxiety in the minds of manufacturers. Beautiful machines, composed of materials which were unheard of before the days of automobile construction, were now being produced which worked from 16 to 18 hours a day continuously, ran 30,000 miles within 12 months, and earned substantial profits; but, unfortunately, the using companies tried to get all they could out of the machines; and this was inconsistent with sound practice. One spare car was required for every six or seven vehicles. If a motor garage was established and conducted on thoroughly sound lines, there would never be a car in it which would not perform its daily function of utility. But, unfortunately, the cars were put on the road and allowed to run themselves to death, the companies often not realising that an efficient inspection every seven or eight days would render the car, at a small expense, serviceable for another week without further outlay. It was difficult in a new industry to instil into the minds of the users the important features which controlled success, and that was a source of worry to the manufacturers. A good deal was heard of electric vehicles, but he thought it would be a long time before the existing motor omnibuses would be supplanted by such machines. At the present time motor omnibuses were running silently at a cost of from 8d. to 8½d. per car mile, including everything except depreciation, and such a cost should yield a substantial profit to the user. All that remained to be done was to put into proper shape, firstly, the authority which controlled the licensing; and, secondly, the using companies which controlled the employment of the vehicle.

Lord MONTAGU, in reply, thought he was to be congratulated on the practical unanimity which had been expressed on the main conclusions of his paper. He would have gone further into the subject of the Municipal aspect of tramways versus motor buses, but, as he stated in his paper, he did not wish to infringe upon a part which peculiarly belonged to the Chairman, or to enter into a subject which was political and controversial before a non-political audience. When recently analysing the cause of the noise on some of the London 'buses, he was very much surprised at the results. In one case he found that two cans near the driver's feet were jarring together; and on the same omnibus, which otherwise was perfectly noiseless, the advertisements, consisting of iron sheets along the top were loose and rattling, the screws being inadequate to retain them in their positions. Such things created unfavourable impressions; and he, therefore, recommended the proprietors and managers of motor omnibuses to see that the interesting advertisements which appeared on their vehicles were secured with strong bolts, or in such a way as to prevent their rattling. He felt quite certain all reasonable motor omnibus advocates would agree that in the future motor omnibus routes must be defined. When he was defending the cause of the motor omnibus in the House of Lords last July, he did not think any prejudice was displayed in the Upper House against it, in fact the reverse; but he thought the public was now making a reasonable demand that motor omnibuses, at any rate at night, should confine themselves to certain main routes. All those who had slept in a building adjoining a motor 'bus route at night would agree that that was a reasonable proposition. He desired to congratulate all those concerned on the increasing reliability of the motor omnibus. He remembered when a 'bus stranded at the side of the street was a common object, but breakdowns had now been considerably lessened, with a corresponding improvement to the industry. The problem of the motor 'bus was a great deal more than a purely mechanical one; it was a great coming force in the nation, for the welfare of the democracy in town and country alike. He believed that free, unfettered, cheap and safe locomotion was exactly analogous to the free circulation of blood in a human being. Just as blood, if it became congested in any part, produced dire results, so the congestion of humanity and their inability to travel easily produced equally bad social results. He was quite certain that the improvement in comfort, noiselessness, and cheapness of the motor 'buses would all tend, not only to make them a most valuable force for good in the towns, but also to the nation as a whole. In conclusion, he desired to refer to the death of M. Serpollet, the pioneer of steam-omnibus traction in France, who had done perhaps more than any other man in the early days of steam-motor public service vehicles for the advancement of the industry. His steam system, though it had its critics, was a very efficient one, and was adopted very widely. He was sure they all condoled with the family of the late M. Serpollet, and with the French scientific world, in the loss they had sustained.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Lord Montagu for his interesting and instructive paper, and the meeting terminated.

GOLD MINING IN KLONDIKE AND ALASKA.

According to recent reports from Dawson a gold dredging epoch is dawning upon the Klondike. The rich, early discovered creeks have already by crude and wasteful methods been worked over. They are now being subjected to another, and more scientific treatment. A prominent feature of the new system is gold dredging. It has proved eminently successful in the Klondike in spite of such drawbacks as difficulties of transportation, high cost of installation and working, frozen gravels and short seasons. Gold dredging in the north has passed the experimental stage, and become an established and prominent industry. Extensive areas of low grade ground which have been lying idle, because under the former manner of mining the cost of extraction would equal, if not exceed, the returns, are being made productive through the use of dredges handling 3,000 or more cubic yards of dirt every twenty-four hours. There are now in the Klondike, either in operation or in course of installation, nearly a dozen gold dredges, and these have been proved of great success. Even the old form of prospecting by shaft sinking has been largely superseded by the use of steam churn drills. The operations of the dredges in 1906 confirmed the results obtained by the pioneer dredges of 1905, viz., that the auriferous gravels in the Klondike which can be treated by dredging are so extensive that placer gold mining there is absolutely assured to be a vast and permanent industry. According to a report from Ottawa the great advantage of workting claims by dredges and efficient hydraulics has become so apparent that during the summer of 1906 the owners of many of the claims on the older creeks and hills preferred not to work their properties by the more primitive method, but to await the installation of dredges or a large supply of water. For this reason the number of gold-yielding claims has been temporarily greatly reduced. Notwithstanding this fact, however, the gold output up to October 31, 1906, amounted to £1,079,000. In 1905 the output for the whole year amounted to £1,500,000. It is stated in a report of the Commissioner of the Yukon territory that on the creeks situated north and west of the Indian River divide, namely Bonanza,

Eldorado, and Hunker creeks, with their tributaries, the primitive placer mining methods have almost entirely given way to modern methods, but on the Indian River side of the divide, owing to the expense of transportation, and the generally more virgin nature of the claims, primitive placer methods, aided by a few mechanical contrivances, are still employed. This section includes Dominion, Gold Run, Eureka, Sulphur, and Quartz creeks, and their tributaries. Another noticeable feature in the mining industry of the Klondike during 1906 was the great activity displayed by prospectors and claim locators. The extent of this can best be shown by comparing the number of claims staked during the two past years with those staked during the four months of July, August, September, and October, 1906. During the fiscal year ended June, 1905, there were 785 claims staked, and 505 during the fiscal year ended June, 1906. During the four months ended October, 31, 1906, there were 1,388 claims staked, that is to say, during the said four months there were more claims staked than during the whole of the two preceding years. While in the north end of the territory placer mining has received nearly the entire attention of miners, in the south end, in the vicinity of Whitehorse and Conrad City, quartz mining has been the principal industry. In the immediate vicinity of Conrad City about £120,000 has been spent in developing the quartz properties. The "Venus," "Vault," "Montana," and "Big Thing" mines have been energetically and systemataiclly developed. Reverting to the question of gold dredges, those so far employed are, according to the United States Consul at Dawson, of American make. Occasionally, it is said that dredges from other countries may enter into competition with American patterns. As a matter of fact, machinery and appliances of a kind not made in Canada, for use exclusively in alluvial gold mining, are admitted free of duty in Canada. Under this provision most of the component parts of a modern gold dredge may enter Yukon territory without paying customs duty. Having passed through the first and primitive stage of gold mining (washing out gold by the use of pans, rockers, cradles, sluices, &c.), the Klondike is now entering upon the second stage of placer mining development, employing hydraulic and dredging machinery. Later on will probably follow the third and still more permanent method of gaining the golden metal, that is, quartz mining. It is expected that the introduction of dredges will greatly increase the output of gold in the Klondike. In 1905 this was reduced to about £1,500,000, as against £2,100,000 in 1904, £3,600,000 in 1901, and £4,450,000 in 1900. Speculation is already rife as to whether this enlarged supply from the Yukon, coupled with Alaska's growing yield of new gold, will not perceptibly affect the general economic conditions in America as a whole. During 1906, it was estimated that Alaska furnished some £4,000,000 of gold, as against £2,900,000 in 1905, £1,800,000 in 1904, and £1,300,000 in 1903. The increase in 1905 in Alaska of gold production was due largely to the opening and working of the Tanana and some minor districts. The output of the Tanana country in 1905 was valued at £980,000. The Nome district remains a large producer, having turned out £920,000 during the year. The receipts of gold bullion at the United States Assay Office at Seattle during 1905 included —From Nome, 225,565 fine ounces; Tanana, 235,324; other Alaska regions, 46,319, and Yukon Territory, 416,432 fine ounces. The Douglas Island mines continue to supply the whole output of lode gold.

IMMIGRATION INTO THE UNITED STATES.

The Hon. R. C. Lindsay, who is the Second Secretary to His Majesty's Embassy at Washington, has written an interestsng report on immigration into the United States, issued as a Foreign-office paper (Cd. 2683). Between 1820, when the United States Bureau of Immigration originated, and 1905, no less than 25,900,000 immigrants reached American shores, and in no year was the immigration so great as in 1905, when it amounted to 1,026,000. The first great impulse was given by the commercial depression in England in 1827 and 1828, and was carried on by hard times in Ireland till 1842, when the 100,000 was first passed, and till 1847, when 234,000 entered. The revolutions on the Continent brought immigration up to 427,000 in 1854, after which it fell, till during the civil war, in 1862, a bare 100,000 entered. After rising to 459,000 in 1873, commercial depression in the United States brought it down again in 1878 to 138,000. In 1882, partly on account of the "May laws" in Prussia, 788,000 immigrants reached America. Diminution then set in, and the commercial depression brought about a low point in 1868 of 229,000, since when the increase has been uninterrupted, and the figures of the present year exceed even those of 1905.

The explanation of the rapid increase in immigration during the last decade is not far to seek. Increased facilities of transit are the first and most obvious cause. The journey is not the great and difficult undertaking it used to be. Fares are cheaper, accommodation better, and sailings regular. Many peasants in Eastern and Central Europe have been induced to sell their plots of land and immigrate by the dreams of easily acquired wealth which touts and runners bring up before them. Mr. Lindsay says that immigrants have been seen to throw their cooking pots into the sea when their vessel enters an American harbour, in the belief that when once ashore new ones were to be had for the asking. Another cause of immigration is the Protective Tariff. By developing certain kinds of industries, and shutting out foreign goods, it creates a demand for certain kinds of labour, and destroys a demand for foreign goods. Obviously,

if the goods are wanted, and may not be imported, producers of them must come in.

Not only has immigration to the United States increased very largely during the last two decades, its character has changed. Up to 1880 it was the people of Northern and Western Europe who contributed the vast majority of foreign population to America, Englishmen, Irishmen, Germans, and Scandinavians, but now the majority comes from Southern and Eastern Europe and is chiefly Latin and Slavonic. This is shown very plainly in the following Table :—

	Nationality.	Average Annual Immigration, 1880-85.	Rate of Illiteracy.	Average Annual Immigration, 1900-05.
		No.	Per Cent.	No.
N. and W. Europe (chiefly Teutonic and Celtic) ...	German	174,109	8	32,583
	Scandinavian	69,665	0·6	53,798
	British	145,708	3	72,248
S. and E. Europe (chiefly Latin and Slavonic) ...	Russian	14 290	26	124,920
	Austro-Hungarian	27.642	26	176,574
	Italian	20.309	48	176,650

It is estimated that 46 per cent. of the present population of the United States is due to immigration which has taken place since Colonial times, but whereas in the past the emigrants were men of northern blood, now nearly three-fourths of them come from Southern and Eastern Europe, with the result that an immense number are illiterates. Of the total number of immigrants in 1905, 725,000 were males, and 300,000 females. 114,000 were under fourteen years of age, 855,000 from fourteen to forty-four years old inclusive, and 56,000 above that age. 238,000 were illiterate, and the total money shown by them on landing was 25,159,012 dollars, or an average of nearly 25 dollars per head. It is a little surprising that whilst the percentage of English immigrants who are illiterate was only 1·8, of Scotch 0·5, and of Irish 2·9, the percentage of German was 3·6. The most illiterate of all are the Ruthenians, the percentage being 59·7, the Lithuanians coming next with a percentage of 52·3, followed close by Southern Italians with a percentage of 51·2. Poverty and ignorance seem to go together, the most illiterate having the least money in their pockets. Thus the Lithuanians average 12·1 dollars, and the Ruthenians 12·04 dollars, whereas the Germans take with them an average of 43·7 dollars, the English 57·40 dollars, and the Scottish 50·06 dollars.

As with other races, the States of New York, Pennsylvania, Massachusetts, and Illinois gain the largest number of British immigrants, but on the whole, Englishmen are better distributed throughout the country than people of other races, and surprisingly large numbers of them are to be found in the far Western States. Of the wage earners, 33 per cent. are professional men or skilled workmen. Englishmen assimilate quickly and easily. The Irish differ in one respect from all other races, in that their female immigrants outnumber the males—29,000 to 24,000 in 1905. Most of the women, like the Scandinavians, are domestic servants of whom Ireland contributes no less than 23,000—last year one-fifth of the total number of servants who arrived. Of the men, about 16,000 are unskilled labourers, but the Irishman is being ousted by cheaper races. The German immigration is one of the oldest and most considerable, and stands second only to that of the United Kingdom. A large proportion of the German immigrants, though not so large as in the case of the British, are engaged in professional and skilled occupations — clerks and carpenters being the most important classes. They are well distributed, but have also concentrated in certain well-defined centres. In New York the German has supplanted the Irish vote in first importance. Chicago contains 170,000 of them, and 60 per cent. of the population in Milwaukee are of this race. They have taken the lead in establishing many industries in the United States, notably that of brewing. They make excellent immigrants, as do the Swedes, Norwegians, and Danes. "Better even than a Norwegian" is a phrase that may be heard sometimes as the highest praise possible for a servant or workman, and it is not easy to know which of the three races is rated highest.

For some time the Italians have formed the largest group of immigrants, but it is thought this immigration has reached its highest point, and the numbers for 1905, high as they were (221,479) did not come up to those of 1903, when 233,000 arrived. Like other races, most of the Italians go to New York (which claimed 90,000 in 1905), Pennsylvania, and Illinois, with large contingents from Massachusetts and Cincinnati. 45,000 Northern Italians found their way to California, where they are mostly engaged in fruit farming, and are doing well. The padrone system is a characteristic feature of Italian immigration. The padrone contracts with the runner or tout in Italy to receive a certain number of able-bodied men, and on arrival he immediately hires them out to work. The disadvantage of the system is that the labourer is mulcted of a small per-centage of his wages as commission, which in his poverty he can ill afford, and that in many cases he must buy his food from the padrone at more or less exorbitant prices. The Italians do not assimilate easily. They congregate in large colonies, and learn English slowly and badly. They are cheerful and improvident, and from the very lowness of their standard of living, they keep fairly clear of pauperism. The average weekly cost of living in a family for an Italian has been worked out to be no more than 82 cents.

The Jewish immigration to the United States is large. Hebrew immigrants almost without exception find their way to the large cities. New York has a

Jewish community of 600,000 souls, and in 1905 received 83,000 more out of a total immigration of 129 000. The remainder go mostly to Pennsylvania, Massachussetts, and Illinois. The Jews are of poor physique, and incapable of heavy and manual labour. They are, therefore, compelled to follow City callings, and, in spite of illiteracy, more than half of the 1905 immigrants were skilled labourers, and no less than 22,000 declared themselves to be tailors. 8,000 were servants, and only 12,000 labourers. Mr. Lindsay says that the Hebrew immigrant does not make so bad a citizen as is usually expected of him. His law-breaking is confined for the most part to some breach in the sanitary regulations committed in the interest of thrift. He is sober, industrious, and shrewd, and intense pride of race generally saves him from falling into the last strata of society. But he is liable to disease, especially tuberculosis, and it is to be feared that his physical degeneration is often accompanied by a deplorable moral degradation, which alone can account for the number of wife desertions in the community. In 1905 the United Hebrew Churches in New York attended to a total number of 10,066 applications for relief, representing 44,000 persons. Of these no less than 1,100 were deserted women, who had 2,890 children.

The Syrians and Armenians seem to be the most undesirable of the immigrants reaching the United States. They form little colonies, and live in a horrid state of dirt and congestion. The first thing they do is to commit their children to the poor-house, and it is said that there are not 100 Syrian children in all the public schools in New York. Their presence in America shows that even the most stringent laws cannot keep out a bad class of immigrant.

The first General Immigration Act was passed in 1882, but nearly every Congress has had the matter under consideration since that date, and in proportion as the flood has risen, the stringency of the laws has been increased by adding to the "excluded" classes, by improving the administrative machinery, and by putting more responsibility on the shipping companies. Though the present law is the outcome of the experience of twenty-five years, there is a general demand for more stringent enactments. The New York Commissioner wrote recently, "I believe that 200,000 and probably more aliens came here last year, who although they may be able to earn a living, yet are not wanted; will be of no benefit to the country, and will, on the contrary, be a detriment, because their presence will tend to lower our standard; and if these 200,000 could have been induced to stay at home, nobody, not even those clamouring for more labour, would have missed them. Their coming has been of benefit chiefly, if not only, to the transportation companies who brought them here." Mr. Lindsay points out that it would be advantageous if a better distribution of emigrants could be brought about. The South is becoming an industrial country, and is dependent for labour mainly on the negro. Employers are almost unanimously agreed as to the extraordinary and increasing efficiency of the coloured labourer, but there is room for much more labour than he can supply. Yet last year the South received only 4 per cent. of the total number of immigrants. Societies for the assistance of emigrants have made endeavours to induce their *protégés* to go to new districts and found new colonies, but with poor success, and until some powerful organisation is set on foot with this object, it is unlikely much progress will be made.

COTTON CULTIVATION IN THE CONGO.

The results of the cultivation of cotton in the Congo Free State in which the Belgian Government has for some time been actively engaged, are now attracting considerable attention. The industry not only includes native cotton, which is found in different parts of the Free State, but also the introduction and cultivation of foreign cotton. Experiments have been made with the best known varieties, such as those of New Orleans, Georgia, Sea Island, Peru, and upper and lower Egypt. The first trials were made to ascertain the peculiarities of each species, the best time to plant, the particular care required for the culture and harvesting of cotton, and also to determine the varieties best adopted to the soil and climate with regard to quality and larger yield. The results of such experiments are being reported to the Congo cotton planters. According to a recent report from Antwerp, the Free State Government has brought out cotton pickers and presses of different patterns for the preparation and baling of the cotton for exportation. It has furthermore engaged the services of a practical American cotton planter, with a view to placing under his direction the management of its vast plantations. The first crop of cotton, in the year 1904, came from experimental plantations in the lower Congo. Samples were submitted to experts who found the quality excellent. Among the varieties produced, the Egyptian, grown in the district of Kalamu in the month of May, was quoted at the highest price, namely, one shilling per pound, other varieties such as that of New Orleans, cultivated under the same conditions, were quoted at a much lower rate. A sample of native cotton from Maiumbe, harvested without any particular care by the natives, was quoted at about seven pence per pound. This product resembles the Indian cotton which is used for coarse manufactures. In the upper Congo, plantations have been laid out, especially in the upper Ituri district, where the climate and soil seem to be particularly favourable to the cotton plant. Contrary to the conditions in other countries, the wooded districts there are not favourable to the cultivation of cotton. The moist atmosphere and the constant rains, which prevail in that part of the Free State territory, are most unfavourable, not so much to the growth of the cotton plant as to its maturing,

harvesting, and shipment. The Botanical Garden at Eala, situated in the equatorial district, is chiefly devoted to the gathering, selection, and distribution of cotton seeds. This establishment is already in a position to supply all demands made for seeds, but nevertheless the Government continues to import the seeds of the best known varieties. Not long ago the attention of the Governor of the Free State was drawn to the fact that the native chiefs would derive great advantages from the cultivation of the cotton plant, inasmuch as it has become acclimatised in all the regions, especially in the lower Congo, and the natives there are now familiar with its culture.

SUGAR-CANE PEST.

According to the American Consul at Trinidad, the sugar-canes in that island have been attacked by a small insect of the group, known as "spittle insects" or "frog hoppers." The name, "spittle insect," is given on account of the peculiarity of the immature insect in covering itself in a mass of white froth, which is voided from the tips of the abdomen, and which forms a complete hiding-place or covering for the insect within. The name, "frog hoppers," is probably derived from the name of frog spittle formerly given to the frothy mass, and from the leaping habit of the insect. Specimens of the infested cane stumps, and of the adult insect, have been sent to the Agricultural Department, and the following account is based on an examination of these specimens. The insect, when it has attained full growth, is about five-sixteenths of an inch in length, and about half as wide. The head and thorax are dark green. The wing covers, light brown, with two narrow whitish bands running across them. The head is stout and broad, the eyes prominent, and there are two small simple eyes on the upper surface of the head, between the large compound eyes. The antennæ are short and hair-like, except the base, which is much thickened. The legs are dark brown and slender, the wing covers are somewhat thickened, while the underwings are pale, tinged with smoky brown. The immature specimens, so far examined, are all in the last larval stage of development. The bodies are whitish, tinged with pink or red, the head and thorax being darker. The developing wings are seen as dark, elongated pods, lying on the basal part of the abdomen. The adults have not been observed in the act of feeding. The immature insects seem always to place themselves on young tender roots, and it is probable that they are able to penetrate the hard rind of the cane with their beaks. They have been found feeding at a distance of four inches below the surface of the soil. The chief of the Trinidad Botanical Gardens, states that this insect appeared on the island a few years ago, during such a season of constant wet weather as the last, and the fact that it has remained comparatively unknown since that time, would indicate that it becomes a pest only is seasons unfavourable to the cane.

ARTS AND CRAFTS.

Wood-carving.—We are all quite well accustomed to old works of art being bought for America. If we hear that a well-known picture has come into the market, or that a collection of any importance is to be sold, we immediately begin to speculate on the likelihood of its finding its way across the Atlantic. It is not quite so usual an occurrence for an American to buy the work of a modern European artist, and still less common for him to place orders in the hands of an English craftsman. He is rather inclined to think that, when it comes to work which is being executed to-day, he can do as well at home as he can elsewhere—if not better. It is, therefore, with a certain feeling of surprise, not unmixed with pleasure, that we learn that the masterpiece of technique in the way of modern wood-carving on view at Mr. Aumonier's studio is destined for New York. Wood-carving is not a craft about which, in the ordinary way, there is very much to say. It has long passed the experimental stage, and no one expects any startling new developments; the nature of the work is fixed within certain fairly rigid boundaries by the limitations of the material and the tools employed. Still, in the most technically perfect of crafts, as well as in the most elementary, there are, from time to time, signs of movement—points of departure from the beaten track—which, though they do not indeed introduce a new technique, or pave the way for violent revolutions or reformations, are at least worth noting as steps forward along the path of craftsmanship. It is just one of these steps forward that seems to have been taken in the piece of work which has just been finished in Mr. Aumonier's workshop. The carving is part of an overmantel for an elaborately appointed room, in a style which implies ornament of a somewhat florid character. It takes the familiar form of a central cartouche, a couple of big, fat swags, and some dependent bunches of flowers, connected by ribbon work and bows of exceptionally graceful design. The carving, which is ultimately to be very lightly gilded with powdered gold—rubbed off in places so as to show the red colour of the composition grinning through—and mounted on a green background, is executed in limewood. The ribbons, naturally in rather lower relief than the rest of the work, are carved out of the solid wood, whilst the projecting parts of the more prominent bunches of ornament which rise to a depth of at least six inches in places, are cunningly planted on. The work is remarkable not only for the height of the relief and the skill of the carving, but for the taste which has induced the carver, in spite of the rather florid style of the design, to treat his work with restraint and breadth. There is nowhere any frittering away of the surface of the wood. Of course, limewood would not keep its colour for long, nor would it turn to a pleasant

tint in its old age, and it would have been impossible to execute this very intricate and deep kind of carving in a less tractable wood; but it seems almost a pity, from one point of view, that a surface which bears such evident traces of skilful workmanship should have to be covered up by a coat of preparation and gilding, no matter how slight. From another standpoint, of course, the effect of the work as a mass may quite possibly be improved by its translation into green and gold.

Stone-carving.—Stone-carving and wood-carving are so closely allied both in theory and in practice, that it is interesting to compare with the piece of work just noticed, the carvings which form part of the exterior decoration of the new building for the United University Club, at the corner of Pall-mall East and Suffolk-street. The comparison is the easier, because in both cases the theme of the ornament is the same, and in spite of the great difference of treatment there is a certain resemblance between the two pieces of work. The ornamental details of the new club have been carved from designs by Mr. Reginald Blomfield, and are thoroughly different in feeling from those in the wood-carving, but in spite of that, and allowing for the limit naturally imposed by the stone upon the craftsman, there is a certain family likeness between the two. The admirable reticence of the design of these stone garlands makes them thoroughly fitted for the place they occupy on the building—whilst the two figures supporting the shield over the main entrance, the work of Mr. Pegram, are in character with the rest of the ornament and with the general style of the building. It is not often that we have so good a chance of seeing at the same time the work of one carver in two materials showing so well the points of likeness and of difference which follow inevitably and naturally from working in different and, in some respects, dissimilar, media—which yet are handled in more or less the same way. It is also interesting to note how well this massive and sparingly-used stone-carving goes with the building it decorates, and how it seems to form an almost necessary part of the building instead of calling undue attention to itself or taking up space which would have been better left free from ornament.

Embroidery.—It is some years now since the public had an opportunity of seeing a really representative collection of modern English embroidery. And it can hardly be said that the exhibition which has just been held at the Grafton Gallery by the Royal School of Art Needlework does more than show the lines upon which one school has been working of late. The school made its name originally by "crewel work," and the authorities are probably wise in keeping this kind of embroidery well to the front in the exhibits—more especially since, at the present time, crewel work in imitation of that done two or three centuries ago is in high favour. One of the most satisfactory pieces of work on show was the valance and set of curtains of medlar trees—designed as well as executed at the school. In this work, as in much of the old embroidery, the back-ground, a kind of bolton sheeting, is left bare and the pattern stands out in many-coloured crewels. The general effect is pleasingly reminiscent of the old work without being in any sense a copy of it—indeed, the design, though by no means what is called "up-to-date," is nothing if not modern in its composition. In the large hangings, executed entirely in crewel embroidery, in which no fraction of the original ground material remains uncovered, the result does not seem proportionate to the labour spent on them, though they are not without interest. These panels are neither more nor less than huge pictures in embroidery. There is a good deal of divergence of opinion on the question of picture-painting in embroidery. Some people hold that what it is possible for the needle to do may well be attempted in needlework. Others are firmly convinced that pictorial effect is out of place in embroidery and that if anything more than ornament is attempted in it, it should be treated so that the final effect is first and foremost needlework—something which could hardly be arrived at by any other method of workmanship—and not a more or less imperfect rendering in silk or crewel of something which could be more perfectly executed with the brush. Whatever we may think on that point, there is no doubt that, for the time being, picture painting in embroidery has come back into prominence. The little show of Miss Button's wonderful and really charming landscapes in embroidery held last year at the Lyceum Club gave striking proof of what it was possible to achieve in this way. The pictures were wonderfully well drawn and very clever use was made in them both of the stitches and the colours employed. But the desire for picture has not stopped short at work like this, and there is a quantity of needlework now being done which does not keep so strictly to the rules of the game. That is very largely because it aims at pictorial effects not to be got by the needle—an aim which stands confessed by the practice which has become customary of painting the smaller and more minute parts of the design (the flesh and various other details) in water colour. This, by the way, is a proceeding which carries us back with unpleasing insistence to a debased period of art. It recalls also a practice of the modern Belgian trade embroiderers whose work, mechanically good as it sometimes is, is by no means artistic. The difference between this kind of thing and the cheap fancy work in which a stencilled filling is outlined and added to by silk embroidery is great indeed, but the commoner work represents only the very thickest end of the self-same wedge.

OBITUARY.

ERNEST GEARING. — Mr. Gearing, managing director of the Leeds Forge Company, died on the 8th inst., in London, after a severe operation, at the age of 57. His early training was obtained at the chief engineer's office of the Union Steamship Company at Southampton. He left the south of England to become the works manager of the shipyard of Messrs. James and George Thomson, Clydebank, Glasgow (now Messrs. John Brown and Co.) and superintended the building of the steamships *City of Paris* and *City of New York*. In 1892 he became general manager and secretary of the Leeds Forge Company, and for the past two years was managing director of the company. Mr. Gearing was elected a member of the Society of Arts in 1896.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock :—

FEBRUARY 20.—"The Commercial Application of Refrigeration." By HAL WILLIAMS. SIR EDWARD MONTAGUE NELSON, K.C.M.G., will preside.

FEBRUARY 27. — "Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts.

MARCH 6.—"The Discovery of the South Eastern Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S. The Right Hon. LORD HARRIS, G.C.S.I., G.C.I.E., will preside.

MARCH 13.—"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

Dates to be hereafter announced :—

"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Engraving and Photogravure." By. J. CRAIG ANNAN.

"Hungarian Arts, Home Home Industries and Commerce." By LOUIS FELBERMAN.

"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon.

"Aerial Navigation." By MAJOR B. F. S. BADEN-POWELL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras. The LORD AMPTHILL, G.C.S.I., G.C.I.E., will preside.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States. SIR FRANK SWETTENHAM, K.C.M.G., will preside.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

MARCH 19. —"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. This paper has been unavoidably postponed from February 19th.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

LECTURE I.—FEB. 25.—What Romanesque is—French examples—Oriental features—The portals at Chartres—Provençal developments—Direct Oriental influence in France and Italy—Norman Romanesque —Tau croziers — Fonts imported from Tournai—Sicilian Romanesque — The zig-zag—Scandinavian patterns—Spanish churches of 9th and 10th centuries.

LECTURE II.—MARCH 4.—Italian examples of Romanesqe ornament—Byzantine art and its formation—Patterns suggested by textiles—Arab influence —Byzantine influence in Italy mixed with Lombard —Subjects from the Arthurian Epic—Use of Byzantine ivories as models — Archaistic stucco work, affected by Byzantine ivories—Classical motifs copied —Decorative arcadings at Venice and Verona—Symbolical subjects.

LECTURE III.—MARCH 11.—Anglian carvings, — The Lindisfarne gospels — Italian workmen and

influence in Northumbria—Anglian ornament based on classical data — Later Comacines, called Lombards, and their activity—Italians in Germany and Byzantine influence on the Rhine—The goldsmiths of the Lower Rhine and the Meuse — Byzantine underlying forms and germs of 12th century patterns —English MSS. of the 10th and 11th century—Details which appear in later ornament—Reciprocal influence of England and Germany, and early influence of England upon France—English and Scots missionaries—The cloister the cradle of Romanesque — English and other ecclesiastical craftsmen, and work done by them—Summing up.

The lectures will be illustrated by lantern slides.

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 18...British Architects, 9, Conduit-street, W., 8 p.m. Sir Charles Nicholson and Mr. H. C. Corlette, "Modern Church Planning."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Professor J. Logan Lobley, "The Spread of the European Fauna."

TUESDAY, FEB. 19...Royal Institution, Albemarle-street, W., 3 p.m. Professor W. Stirling, "The Visual Apparatus of Man and Animals." (Lecture II.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Colonel R. E. B. Crompton's paper, "Modern Motor Vehicles."

Statistical, 5, Adelphi terrace, Strand, W.C., 5 p.m. Mr. G. Udney Yule, "Statistics of Production and the Census of Production Act (1906)."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. Mr. John B. C. Kershaw, "The Present Position and Future Prospects of the Electrolytic Alkali and Bleach Industry."

WEDNESDAY, FEB. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Hal Williams, "The Commercial Application of Refrigeration."

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. Edward Mawley, "Report on the Phenological Observations for 1906." 2. Mr. Richard Inwards, "The Metric System in Meteorology."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. J. W. Gordon, "An Early Criticism of the Abbe Theory." 2. Mr. James Murray, "Some Tardigrada of the Sikkim Himalaya." 3. Dr. Eugène Penard, "Some Rhizopods from the Sikkim Himalaya."

United Service Institution, Whitehall, S.W., 3 p.m. Sir George Arthur, "Education in Relation to the Army."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, FEB. 21...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. The Percy Sladen Trust Expedition to the Indian Ocean. 1. Mr. J. Stanley Gardiner. Introduction. (Part I.) "Ceylon to Mauritius." 2. Mr. R. C. Punnett, "Land Nemerteans, with a Note on the Distribution of the Group." 3. Mr. L. A. Borradaile, "Land Caustaceans." 4. W. P. Cameron, "Hymenoptera." 5. W. F. F. Laidlaw, "Dragon Flies." 6. Professor A. Torel, "Fourmis des Seychelles, Admirantes, Farquhar et Chayos." 7. Professor G. H. Carpenter, "Pycnogonida."

Chemical, Burlington-house, W., 8½ p.m. 1 Mr. W. B. Tuck, "The Constitution of Oxyazo Compounds." 2. Messrs. T. S. Patterson and A. McMillan, "The Influence of Solvents on the Rotation of Optically active Compounds. Part IX. A New General Method for Studying Intramolecular-change." 3. Messrs. J. C. Irvine and A. M. Moodie, "The Reduction Products of Ortho- and Para-Dimethoxybenzoin." 4. Mr. G. Senter, "Replacement of Halogens by Hydroxyl. I. The Hydrolytic Decomposition of Hydrogen and Sodium Monochloroacetates by Water and by Alkali, and the Influence of Neutral Salts on the Reaction Velocities." 5. Messrs. A. D. Hall and C. T. Gimingham, "The Reaction of Ammonium Salts with the Constituents of the Soil."

Royal Institution, Albemarle-street, W., 3 p.m. Mr. Alfred Harker, "The Minute Structure of Ignious Rocks and their Significance." (Lecture II.)

Optical, 20, Hanover-square, W., 8 p.m. Dr. W. Ettles, "The Ophthalmometer."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Professor J. J. Thomson, "Modern Theory of Conduction of Electricity in Metals."

Historical, Field-court, Gray's-inn, W.C., 5 p.m. Annual Meeting.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, FEB. 22...Royal Institution, Albemarle-street, W., 9 p.m. Mr. Dugald Clerk, "Flame in Gas and Petrol Motors."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. F. E. Walker, "Impurities in Boiler Feed-Water: their Nature, Effect and Elimination."

Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.

East India Association, Caxton-hall, Westminster Town-hall, S.W., 4 p.m. Mr. J. D. Anderson, "Constitutional Problems in India."

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Physics Laboratory of the Royal College of Science, South Kensington, S.W., 5 p.m. Professor Lyle, "Transformer Indicator Diagrams." Professor Bragg, "Ionisation of Gases by α Particles of Radium." Mr. B. Roberts, "A Micromanometer."

SATURDAY, FEB. 23...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Röntgen, Cathode, and Positive Rays." (Lecture II.)

NOTICE TO LIBRARIES.—The Secretary of the Society has in his possession a series of British Association Reports from 1878 to 1890 (13 volumes), and a series from 1872 to 1889, with the exception of 1881 (17 volumes). These he will be glad to present to any Library, or Institution, which would like to have them.

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FRIDAY, FEBRUARY 22, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, FEBRUARY 25, 8 p.m. (Cantor Lecture.) F. HAMILTON JACKSON, "Romanesque Ornament." (Lecture I.)

WEDNESDAY, FEBRUARY 27, 8 p.m. (Ordinary Meeting.) ARTHUR E. MORTON, "Modern Typewriters and Accessories."

Further details of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

ELEVENTH ORDINARY MEETING.

Wednesday, February 20th, 1907; Sir E. MONTAGUE NELSON, K.C.M.G., in the chair.

The following candidates were proposed for election as members of the Society:—

Aiyar, Narayana P. Hara, Local Fund Engineer, Anantapoor, Madras, India.
Alston, John, 88, Bishopsgate-street Within, E.C.
Clarke, His Honour Judge R. Johnson, 189, Broad-street, Monrovia, Liberia, West Africa.
Harward, Francis Vernon, 83, Dartmouth-road, Cricklewood, N.W.
Healey, Alfred E., 35, Marlborough-hill, N.W., and Constitutional Club, Northumberland-avenue, W.C.
Knowles, George Potter, Assoc.M.Inst.C.E., F.S.I., 39, Victoria-street, S.W.
Rutherford, Hon. A. C., Strathcona, Alberta, Canada.

The following candidates were balloted for and duly elected members of the Society:—

Clarke, Allen H., 74, Inverness-terrace, W.
King, Captain Alexander E., R.A., Ordnance Office, Citadel, Cairo, Egypt.
Mansell, Major John Herbert, R.A., 108, Shooters-hill-road, Blackheath, S.E.
Prevatt, Francis C., 106, Henry-street, Port of Spain, Trinidad, British West Indies.
Tanner, William Hugh, Public Works Department, Mombasa, British East Africa.
Weston, Robert Ogilvy, M.Inst.M.M.,A.M.I. Mech.E., The Globe and Phœnix Gold Mining Company, Limited, Que Que, Rhodesia, South Africa.
Yate, Colonel Charles Edward, C.S.I., C.M.G., 17, Prince of Wales's-terrace, W.

The paper read was—

THE COMMERCIAL APPLICATION OF REFRIGERATION.

By HAL WILLIAMS, M.Inst.M.E., &c.

The object of this paper is to bring to your notice the wonderful field which has developed for the application of refrigeration in the industrial world. Twenty-seven years ago mechanical refrigeration in a commercial sense was just beginning to feel its feet, and by means of the Bell Coleman Dry Air Machine, which produced its refrigerating effect by the compression, cooling, and expansion of air, perishable produce was first transported across the Atlantic. A few years later frozen mutton was being safely brought from New Zealand. An interesting account of the difficulties encountered by the pioneers in this trade was given to this Society by Sir Montague Nelson, our present Chairman, in a paper which he read some years ago.* The successful transport of frozen and chilled commodities by a natural sequence of events made it necessary for cold storage accommodation to be provided in this country for the reception of the produce which was being brought over. This method of trading in perishable produce opened such an enormous field for development that cold store after cold store, refrigerating depôt after refrigerating depôt, has been established, until now there are few towns in this country which cannot boast cold storage accommodation in some form or another, and there exists the Cold Storage

* See *Journal*, vol. xliii., p. 420.

and Ice Association which (*inter alia*) promotes and fosters the interests of the industry.

Mr. R. Maynard Leonard, the able editor of *Cold Storage*, has happily remarked upon the fact that the enormous trade in food products which has thus sprung up has an importance all its own, that is to say, it is becoming a political factor of the utmost consequence. Man cannot live by bread alone, and, as a writer in the *Engineer* pointed out some time ago, cold storage is "a phenomenon the international, political, and social importance of which is incalculably great."

It was also stated that "as food is the most fundamental material interest of mankind, this modern identical fact of cold storage is an irresistible political factor in enforcing the ever-increasing dependence for its natural welfare of each part of the world on all other parts." Mr. Leonard has deduced from these facts an overwhelming case against fiscal reform. In this, I regret that I am not at one with him, and, though I do not want to stray into a fiscal field, I should like to say that I have come to an exactly opposite conclusion. There is, however, another side of the picture about which there can be no question, and that is the extraordinary difference that cold storage of food has made in the health and comfort of the crews and passengers of liners and other steamships. It is doubtful whether, since the introduction of electric light, there has been any development of science which has proved such a boon to life on shipboard.

I do not propose to dwell for any length of time on the particular application of refrigeration to the supply of food, as the topic, from frequent use, is becoming somewhat hackneyed. I fully recognise also how extremely dull, to the majority of people, figures always are. It may be, however, that there are some members of the minority here to-night, and I am sure you will forgive me if for their sakes I point out that twenty years ago (1887), 1,500,000 sheep and lambs were imported from New Zealand, Australia, and South America, while last year (1906) from the same sources 8,800,000 were imported. One new refrigerated vessel alone could bring to London in a single voyage enough meat to give 1½ lbs. of beef or mutton to every man, woman, and child living within the bounds of the metropolis.

Refrigeration is also used for the manufacture of ice for domestic consumption. We in England have not yet cultivated what the Americans called the "ice water thirst," and I sometimes fancy, and always hope, that our damp climate will considerably militate against our ever doing so. Still, however readily the Western daughter may come East, the sun always advances towards the West, and it is difficult to know exactly what the future holds.

A great deal of the ice used in this country is imported from Norway; the balance is manufactured. Ice-making in this country, however, is to a very great extent a one-season business, and on those rare occasions when we do get a hot summer the ice factories are kept busily at work. In the winter, of course, their trade falls off. One of the best customers of the ice factories in nearly all cases is the "hokey-pokey" man with his decorated barrow of succulent, if germ-laden ice-cream. The germs, I may explain, are in the cream, not in the ice.

These are the two best known applications of refrigeration; there are, however, a whole host of other trade applications which are little known, and in many cases not even guessed at.

Refrigeration is applied by florists to the preservation of their choicest cut blooms, by nurserymen to the retardation of flowering shrubs and plants, such as lilacs, lilies, and other blooms for which there is a ready sale. It is also used by butchers, fishmongers, poulterers, brewers, chocolate manufacturers, dairymen, gelatine manufacturers, biscuit-makers, watchmakers, wine growers, iron smelters, hop merchants, horticulturists, and cheese makers.

It is used in the crystallisation of sugar and of salt; in the clarifying and concentration of wine; in the manufacture of explosives; in what are known as champagne factories; by candle-makers and oil merchants, by soap makers, stearine and paraffin wax refiners, by soda-water makers, margarine manufacturers; in bacon curing, in chemical manufactures, in cooling ammunition magazines on men-of-war, in the banana trade with the West Indies, in the manufacture of non-deposit beer, in shaft sinking, in mortuaries, and as a most valuable aid to pathological science. Another application upon which I will touch presently opens the field for the application of refrigeration to every trade in which it is necessary to remove moisture from the article manufactured or in process of manufacture.

It will perhaps be interesting briefly and generally to point out to you the way in which the application of refrigeration to all these in-

dustries varies, and to describe in a few words the peculiar uses to which it is put, why it is wanted, and the methods of application which are necessary to ensure the best results being obtained.

The use of refrigeration in hotels comprises the cooling of rooms for keeping meat, fruit, vegetables, and poultry, receptacles for keeping butter, milk and cream, coolers for containing wine and mineral waters, coolers for refrigerating water for drinking purposes, service refrigerators attached to every larder for keeping prepared food and made dishes in good order and condition before they are placed on the table, and a host of other minor applications which readily occur to the fertile minds of the chefs.

It is hardly possible to give refrigerating machinery a more difficult task than that of maintaining low temperatures in the cold rooms and expedition refrigerators in hotels. The kitchen staff is nearly always composed of Frenchmen, and the erratic, and often persistent, manner in which they leave the doors of the cold chambers open, leads one to believe that the laws of heat and cold in France must be different from those observed in other countries. If you add to this the fact that any article, from boiling soup to a live cray-fish, finds its way into the cold rooms, it will be obvious that the refrigerating capacity required has to be abnormally large to cope with the duty.

In spite of all these difficulties, however, a refrigerating installation has proved such a boon to all good chefs, that all hotels of any importance now have their cold chambers and their expedition refrigerators. In this connection it might be noted as a curious fact that all French chefs love ice, while, were it possible, Italians would, I believe, sleep in it ; at any rate they are better than any other nationality at handling it.

The enormous international trade which refrigeration has bred and fostered now makes it possible for a poulterer to stock his cold rooms with large quantities of foreign game which are brought over in a frozen condition, and to hold them until such time as the market is most favourable for their sale. In the same way fresh fish is kept on ice, while frozen fish is kept packed in boxes at a temperature of 16° Fahr. until it can be thawed out and sold. The frozen goods are taken from the cold room and placed in a room which is heated by electric radiators or similar means. This process of thawing, though useless for beef or mutton, is perfectly satisfactory for small articles, and the goods ready for sale are found to have suffered in no way from their long and chilly rest.

The success of the modern method of fishing by means of steam trawlers is almost entirely dependent upon a plentiful and cheap supply of ice, and the contents of the full hold of a trawler, if examined, will be found to consist of alternate layers of fish and ice. In this way the fish can be kept for a considerable length of time. In some trawlers, which were recently designed for a fishing company in New Zealand, a complete refrigerating and ice-making apparatus was fitted on board the boats, in order to manufacture ice for the purpose of keeping the fish during the length of the cruise, this step being rendered necessary owing to the fact that ice is not at present so easily obtainable in the coast-wise towns of New Zealand as it is in England. Several of our own trawlers now have cold chambers on board.

The bulk of the English fish supply undoubtedly comes from the North Sea, and every day Hull and Grimsby send enormous quantities of fish packed in ice by special trains all over the country. The waters of the South of Ireland, however, teem with fish, and there is no doubt that a little enterprise, aided by refrigeration, could profitably tap that source of supply for the English market. In this connection the newly-opened Fishguard route sounds propitious.

Amongst butchers the science of keeping and maturing meat for sale in large cities is of comparatively recent growth, and now all the best butchers have their cold stores, in which the meat is hung for days at a temperature of 35° Fahr. to mature. When matured it is removed for a day or two into a room having a temperature of 45°, in order that the temperature of the meat may gradually rise to such an extent that moisture from the atmosphere will not condense upon it, and spoil its appearance. It is extraordinary what a difference in flavour and edibility can be produced in apparently tough meat by maturing it in this way. Maturing meat has thus become the great secret of a high-class butcher's trade, and it is largely because the American and Argentine beef has matured and become tender on its voyage across the Atlantic that it is so delicious to eat and sells so readily. Mutton requires maturing in exactly the same way, and the butcher who desires to do a good business and earn a good name will never sell meat freshly killed.

The same rule applies to frozen mutton and frozen beef, but it must not be forgotten that these two articles when frozen remain for all practical purposes in *statu quo* until they are sent to market on this side. When they are thawed, they are, to all intents and purposes, fresh killed meat, and should be treated as such.

The essential feature in all chill rooms where unfrozen meat or articles of food are kept is ventilation. The ideal refrigerator for a butcher is an east wind. Absence of ventilation means a still and stuffy atmosphere, which in its turn means tainted meat.

There is no doubt also that a cool atmosphere is a great aid to prolonging the life of cut blooms, and in this way refrigeration comes to the aid of the florist. I recently designed some cooling chambers for a large West-end florist, and I am given to understand that in the summer great benefit is derived from keeping the cut blooms in a temperature of 45° during the night, and until they are wanted in the shop for sale.

It is, however, to the horticulturist that refrigeration has come as the greatest surprise and assistance. In the past, plant life has been retarded or advanced by the absence or presence of light and heat, and, by means of artificial heat, both fruit and flowers have been produced out of due season. This out-of-season production has, if possible, been brought to a greater state of perfection by the antithesis of this arrangement, or by the retardation of the development of life by placing the roots in a cold temperature. The principle is fairly obvious: all living things require a period of rest. In the vegetable kingdom, with a few exceptions, this rest is taken in the winter, while the work is done in the summer. In a cold store it is always winter, and so long as the life of the plant is not retarded to the point of extinction, its generation of new life can be kept back almost indefinitely.

With this knowledge, and the proper facilities for making use of it, at his disposal, the gardener of the day becomes practically master of the situation, and can make plants and flowers bloom or fruit just as and when he pleases. In fact, it is quite possible to-day to give an order to a horticulturist for a thousand lily of the valley blooms to be delivered at your residence on the 20th of June, July, or August next, or in fact any other date, and to pass the interval of time in perfect security that the order will be duly fulfilled.

There appears to be no reason why practically any root plant should not be capable of having its growth retarded by cold storage. Its use is at present confined to retarding varieties of bulbs, but any perennial should be, within limits, susceptible to the same treatment.

The method employed with lilies of the valley is as follows:—The roots are taken straight out of the cold store, and after they have been thawed in the ordinary atmosphere, are planted out under glass in beds or pots in the ordinary way. Lily of the valley crowns which have not been artificially retarded take six weeks in which to flower. Retarded roots are much more vigorous. The influence of warmth and dampness rapidly stimulates the dormant vitality. In a few days they begin to shoot, in a week the plants are growing strongly, and in less than a month they are in full bloom. It is a curious thing that the prolonged rest appears to have the effect of making the growth exceedingly rapid, once it is started.

It is an unfortunate thing that the climate in England is so changeable, for so long as the weather insists in reversing and mixing up the seasons as it does at present, it is necessary to keep a large selection of clothes of different degrees of warmth within easy reach, and it is consequently impossible for people to avail themseles to the fullest extent of the advantages offered by keeping their winter wardrobe in cold storage during the summer. Were it not for this, there is no doubt that a great benefit would be derived in several ways from sending one's stock of winter clothes and blankets into cold storage during the summer months when moths are most destructive. So fully has this become recognised, that a number of the largest furriers and woollen merchants have added cold stores to their establishments for the purpose of keeping the more valuable goods safe from the ravages of the moth. These cold storage rooms are kept at reduced temperatures, and are cooled by cold air circulation. The furs are kept hanging in bags which are suspended in the current of cold air. The blankets and woollen goods are folded and placed round the rooms on shelves. The furs which are stored for customers are taken in in the spring, when they are no longer required by their owners, and placed in the bags previously mentioned, which are sealed, and the seal remains unbroken until the owner comes to claim the goods. The principle is one which is likely to be considerably ex-

tended, and I have no doubt that in due course it will become quite an ordinary matter for households to send their out-of-season wearing apparel to cold stores to be kept safely for them.

If mechanical refrigeration has been a good friend to purveyors of perishable produce, it has also been a good friend to the brewer. In the process of brewing it is necessary to cool rapidly the wort, which is the liquid resulting from the mashing of malt and the boiling of the extract with hops after it comes from the coppers and before it is pitched with yeast for fermenting. It is also necessary to cool it and remove the heat of fermentation which is generated by the action of the yeast microbe. The heat to be removed during the former process is that which has been put into it during the process of manufacture; the heat to be removed during the latter process is caused by a more interesting state of affairs. During the conversion of barley into malt a substance is formed which is known as diastase. This converts the insoluble starch of the barley into a soluble and fermentable sugar, and this sugar, when absorbed as oxygen by the yeast, splits up into nearly equal proportions of CO_2 and alcohol. The true yeast microbe is a special form of cell whose normal condition of existence is one remove from the air, *i.e.*, anaerobic. It feeds on the nitrogenous matter present in the wort and breathes the combined oxygen of the sugar in the malt, splitting it up as described. The fermentable body, therefore, is the one capable of giving up its oxygen, and the ferment is the microbe having the power of taking it. Under the action of this microbe the excess of nitrogenous matter is absorbed, fermentability is decreased by the transformation of the sugar, and the beer is made staple by the addition in an active form of the alcohol which was previously present in the maltose in a passive one.

In addition to these two principal purposes, refrigeration is also used in breweries for keeping the beer cool while it is got into condition for sending out for bottling. In lager beer breweries refrigeration is essential. The lager beer itself is much less stable than the ordinary British ale on account of the comparatively small quantity of alcohol which it contains. In order to keep it in condition, therefore, it is necessary to maintain it at a low temperature, and for this reason lager beer is always kept and served in a cooled condition. Since grocers' licences were granted, and the Act which prohibited children from fetching beer from public houses except in a sealed vessel came into force, a great stimulus has been given to the sale of beer in a bottled condition. To get the best results from this beer, it is necessary to get rid of the deposit which always exists in beer, and which, as a matter of fact, is made up of the bodies of deceased yeast microbes. This is done by special treatment, and what is known as non-deposit beer is the result. The production of this non-deposit beer is effected by chilling, filtering, and carbonating the beer before bottling. The process of chilling is carried out by bringing the beer into intimate contact with brine artificially chilled by a refrigerating machine. The beer is then rapidly cooled from a temperature of 60° or thereabouts, to a temperature of 28° or 30°. It is then carbonated, filtered, and bottled. The lower the temperature of water or beer, the more CO_2 it is capable of absorbing. For this reason the beer previously referred to is reduced in temperature before carbonating. For this reason also soda water manufacturers are conscious of the advantages which the installation of refrigerating machinery gives them by reducing the temperature of the water before carbonating, thus producing a better quality of mineral water than is possible at ordinary temperatures.

It is a well-known fact amongst dairymaids and other people with agricultural instincts that the returns of butter from cream are to a large extent dependent on the temperature. Thus, if cream is reduced to a temperature of 48° Fahr. before churning, a much larger quantity and a much better quality of butter can be obtained from a given quantity than if it is churned at ordinary temperatures. At the same time, and in curious contradistinction, the cream will more readily separate from the milk at a temperature of 160° Fahr. than at any other. We thus have the peculiar phenomenon that, in order to separate the cream from the milk, high temperatures must be employed, while in order to separate the butter from the cream a low temperature must be used. Nature knows her own reasons best, but the superficial observer might perhaps be pardoned for thinking that in arranging matters in this way she gives an unnecessary amount of trouble. There is, however, method in her madness, because it is an undoubted fact that if milk is sterilised it is a less dangerous food than if it is not so treated. The bacteria which are so active, and which find so congenial a home in milk,

can be destroyed by sterilisation. Sterilisation can be attained at a temperature of 180° Fahr. This temperature, it is true, is not sufficiently high to afford absolute immunity from bacteria, but for all practical purposes it is sufficient, and there is no danger of burning. Thus we see the method, for though they have nothing to do with each other, the temperature which is desirable for sterilisation, which in itself is often very desirable, is also profitable for separation. It will probably be conceded by a student of human nature that nature was wise, and that many people who will not take the trouble to heat their milk to the sterilisation temperature for a good motive alone will do so when there is profit attached to it.

After pasturisation and separation, the milk is cooled down by refrigeration, and is returned to the farmers for calf feeding and other purposes. The cream is cooled rapidly in a similar manner, until it reaches a temperature of about 50°. At this temperature it is run into earthenware vats where it ripens for the churn. Practically it ferments, and owing to this lactic fermentation, the temperature rises to 70°, in the same manner as with wort in the brewery. In from 15 to 20 hours the cream is ripe and ready to be churned, but in order that the fat globules may not be broken and the butter become oily, and in order also, as we have seen, that the yield may be as large as possible, the cream is again cooled down to a temperature of 48°. In some 45 minutes the churning is complete, and the butter floats on the top of the whey in a fine firm condition.

In order to conduct this process, refrigeration is essential; in other respects it is a great advantage, in that it is highly desirable to chill the butter and cream before marketing it.

There is another use for refrigeration to be found in drying, and apart from the process benefits, by which is meant the advantages to the material being manufactured, of being able to dry at a low temperature, there is a second and more obvious benefit in drying by refrigeration rather than by heat—and that is, it is more economical. Except in very dry climates—and England has certainly not a dry climate—the atmosphere is saturated with vapour of water. The amount of this vapour which the atmosphere is capable of holding varies with the temperature, and this is why dew is deposited on the grass at night when the atmosphere is cold and is evaporated again in the morning when the air has been warmed by the sun. This evaporating principle has from the earliest ages been applied to drying, and when moisture has had to be removed rapidly from an article heat has been applied to it. By this heat the capacity of the surrounding air for absorbing water has been increased, and the moisture has been transferred from the article to the air. Were it practical continually to increase the temperature of this air it would be capable of taking up more and more moisture, but it is not practical, and therefore, when the air has become charged with moisture, it either ceases to do any drying or must be allowed to escape to make room for cold air, which in its turn is heated, saturated, and allowed to go to waste.

I do not know whether any of you have ever noticed that when you have a particularly obstinate problem confronting you a solution is often most easily reached by a complete reversal of all the elements involved. Thus, in drying by refrigerating, instead of continually heating air to a high temperature to raise its dew point, we lower its dew point and freeze the water out. Instead of admitting fresh air and letting the moisture-laden air go to waste, we use the same air over and over again.

Let us take a concrete example and explain how it is done. The goods to be dried are placed in an air-tight room: the air from this room is sucked by a fan and blown over a nest of coils which are kept at a low temperature by a refrigerating machine. In passing over these coils the air is reduced from a temperature of say 70° to a temperature of say 30°, or a 40° drop. At the low temperature it can no longer contain its moisture and this is deposited in the form of water or snow on the refrigerated coils. The air leaving the refrigerated coils at a temperature of 30° passes over some steam coils, which once more raise its temperature to 70°. It then passes back into the air-tight room, and when it comes in contact with the goods to be dried it is a perfectly dry air at a temperature of 60° and eager to absorb every drop of moisture it can. Owing to the outside air being at a temperature of, say, 60°, there is little or no loss of heat from the drying-room by radiation; therefore, all heat put into the air is usefully employed in drying the goods.

The duty to be done by the refrigerating machine consists in cooling so many cubic feet of air and in freezing out so many pounds of water; the duty to be done by the heating coil consists in heating the same quantity of

air to a temperature of 70°. The coal expended, therefore, does the work (*a*) of furnishing power to the refrigerating machine, and (*b*) of heating the air between the refrigerating coil and the drying chamber. It is a well recognised principle in refrigeration that a small number of thermal units expended in power can, under certain conditions, account for quite a large quantity of thermal units abstracted as heat; thus in freezing water a cooling effect of over 50,000 thermal units can be produced by the expenditure of 25,000 thermal units as power, and when the range of heat transference is less, as in the case of drying, this difference, or the ratio of heat extracted to work done, *i.e.*, the co-efficient of performance will be much greater and therefore the process much more economical.

It is frequently urged that where a large quantity of drying has to be done it is more economical to use steam engines for power and to dry with the heat of the exhaust steam than it is to adopt any other means of producing power or effecting drying. With exhaust steam the stock expression is "I get my heating done for nothing." If you don't think, the argument seems conclusive, but, if you do think it is really very erroneous, and a few minutes' consideration will show why. In order to make steam 1,000 B.Th.U. are required by every pound of water evaporated, a further 126 units are required per pound to raise that steam to a pressure of 100 lbs. per square inch; these 126 units or thereabouts are absorbed in the engine as work, the 1,000 remain in the exhaust. As no steam-engine can work with a closed exhaust pipe unless it is connected to a condenser, all exhaust heating coils have to have an open end through which a very large quantity of exhaust steam with all its heat escapes. If it were not allowed to escape freely the back pressure would be enormous, the engine would choke, and the power would be most inefficient.

For the sake of argument, take an engine of 100 horse-power, using 25 lbs. of steam per horse-power per hour at 100 lbs. pressure. The figures would be—heat in the steam 2,815,000 B.Th.U., of this 315,000 would be usefully employed in the engine as work, the balance, or 2,500,000, would be a waste product, some of which would be used for heating, but the greater portion of which must, owing to the exigencies of the case, be absolutely lost. It is very much a case of burning down the pig-sty to get roast pork.

Contrast this with the modern system. Power is produced by a gas-engine working with power gas. This is known to be quite four times as economical as the most efficient steam-engine. This gas-engine drives a refrigerating machine, which is really a heat pump and is most efficient when the range of temperature is small. This machine has to cool the air and extract the moisture—the lion's share of the work. The boiler has only to heat the cooled air, a much easier task. Further, it can heat it from a closed coil, where all the latent heat of the steam is made use of and none escapes as in the exhaust of an engine. We have already seen that at low temperature ranges, a refrigerating machine can remove heat in heat units far in excess of the heat in heat units taken as power to drive it; so that by the combination under review we effect the following economies:—First, superior economy of the gas-engine over the steam-engine; second, the superior economy of the refrigerating machine over the exhaust steam; and third, the superior economy of the closed heating coil over the open one. Add to this the superior manufacturing results obtained from drying at a low temperature, and the advantage of drying by refrigeration should be fairly obvious.

Drying by refrigeration has also been made use of on a very large scale for drying the moisture out of the air supplied to the blast furnaces employed in smelting iron ore. This application is a comparatively modern one, for though it has for many years been recognised by iron smelters that the blast furnaces are affected to a remarkable degree by the variations in the humidity of the atmosphere, the theoretical saving by the removal of this humidity has not been sufficient to justify any considerable outlay of capital. These theoretical considerations only take into account the heat which is absorbed in the furnace by the disassociation of the water vapour in the air blast and consequently only show a saving effected of about 4½ per cent. There are, however, very strong reasons to believe that the removal of the moisture from the blast has a very marked effect upon the oxidisation of the carbon in the coke, considerably increasing it, and consequently the evolution of heat per pound of coke handled.

In the years before 1904, Mr. James Gayley, of Pittsburg, gave considerable attention to this point, and so impressed did he become with the fact that the removal of the moisture from the air blast supplied to blast furnaces working under average efficiency

would effect large savings in coke consumption and increase the output of pig-iron, that he persuaded the Carnegie Steel Company to install an apparatus at its Isabella furnace at Etna, Pittsburg.

It must be remembered in considering this matter that the atmosphere frequently contains as much as 5 and 6 grains of water per cubic foot. From observations taken on the N.E. coast of England, the grains of moisture per cubic foot varied from a maximum of 5·14 in July to 2·83 in February, while in Cardiff the moisture was, as might have been expected, rather in excess of this.

One grain of water per cubit foot of air is equal to one gallon of water per hour per thousand cubic feet of air used per minute, or practically one gallon of water per hour. As a blast furnace of average size consumes about 40,000 cubic feet of air per minute, and as the atmosphere contains as much as 5 grains per cubit foot, the amount of moisture carried into the furnace would be equal to 200 gallons per hour.

As I have said, the theoretical loss produced by the evaporation of this water is not so very great, but, adding to this the practical gains obtained from the higher oxidisation of the carbon to which I have previously referred, the gains are very considerable, and, in fact, the economy observed by Mr. Gayley at Etna, resulting from a reduction of moisture contained in the blast from 5·60 grains per cubic foot to 1·75 grain per cubic foot, was an increase of pig-iron produced of about 25 per cent., and a reduction in coke consumed of about 20 per cent.

To instance a common illustration of the effect the moisture in the air has on heat and combustion, many of you will probably recall to mind the common saying: "It is freezing to-night, look how brightly the fire burns," this being only another way of stating that the atmosphere outside is dry.

To show how important the matter really is, and what enormous interests are involved, Messrs. Guest, Keen and Nettlefold decided only last year to spend many thousands of pounds on a refrigerating plant solely for the purpose of drying the air which was being blown into their blast furnaces.

I am afraid that if I continue to describe in detail the multitudinous applications of refrigeration you will grow extremely tired of the subject. I propose, therefore, to summarise more briefly those applications which I have not yet touched upon.

In chocolate factories refrigeration is of the utmost consequence, as, the melting point of chocolate being comparatively low, the process of manufacture cannot be carried out with any degree of certainty during the summer months. Further than this, our old enemy, moisture, again attacks us, for the sweets cannot be properly manufactured if the atmosphere is too moist. It is necessary, therefore, to provide means for cooling the chocolate down during the process of manufacture, and to dry the atmosphere of the rooms in which it is being made. The method of attaining these two ends must naturally vary with the circumstances of the case, and the quality of the chocolate manufactured; as the better class chocolates can always stand a higher temperature than the cheaper sweets. One of the difficulties presented in connection with applying refrigeration to factories where processes of this nature are being carried out is the fact that not only have the goods themselves to be cooled, but also the people employed in making them. In a refrigerating installation which I designed recently for a factory, the bulk of the work imposed upon the refrigerating machine consisted in removing the heat and moisture given off by over 100 girls who were working in the rooms, and in cooling the fresh air which they required to breathe.

The application of refrigeration to the manufacture of gelatine is somewhat similar, for it is required to enable the gelatine to set rapidly during the hot weather. Gelatine is, as many of you are aware, largely used in the manufacture of photographic plates and films. It is also used for the propagation of microbes and similar organisms in the lower scale of life. The indiscriminate propagation of these organisms, however, is not always desirable, and therefore it is necessary when manufacturing gelatine in bulk, to cool it down and make it set as rapidly as possible, in order to prevent the stray microbes from the atmosphere alighting upon it and setting up house.

When photographic films are being manufactured the atmosphere in the rooms has to be cooled, dried, and cleaned. For this purpose the air used in the room is, or should be, blown through water which is kept at a low temperature by refrigeration, and subsequently heated to the desired temperature. The act of blowing the air through the water not only cools it, but removes all particles of dust which would otherwise exercise a bad effect on the films and plates.

Refrigeration is utilised by watchmakers for the maintenance of an even temperature for the purpose of regulating and standardising their instruments; by hop merchants for preserving in the hops the essential oils which give them their peculiar aroma and flavour, and constitutes their value in the process of brewing; by cheesemakers in the storage and ripening of cheese, and it is in fact due to the systematic ripening of Canadian cheeses in cold storage before they are imported into this country that the market receives them so favourably, and is prepared to pay so high a price for them.

Attempts have been made in France for many years to try and concentrate the very light wines which are produced in such quantities, and contain such a low percentage of alcohol as to render them practically unfit for export purposes. These wines usually contain a great amount of albuminoids, which produce cloudiness in the wine when it is brought to a low temperature. The clarification of the wine is a simple matter, but the concentration has always presented considerable difficulties, for though a portion of the water could be frozen out, it was found that the water so frozen still retained considerable portions of the alcohol which it was desired to retain.

An Italian professor has, by a more or less secret process, overcome the difficulty, and has found that it is possible, by freezing the whole body of wine and filtering through it certain solutions, to concentrate it to the desired degree. The same process is now being applied to treating all sorts of sugary and syrupy solutions, and in the near future refrigeration will probably find a home in the sugar factories where concentration is now carried out by evaporation in vacuum pans and multiple effects.

In mining work refrigeration comes into play by enabling shafts to be sunk through water-bearing strata, or through running sand. The process employed is to drive a number of tube wells into the ground, in a circle surrounding the position in which it is desired to sink the shaft. Refrigerated brine is circulated through these tubes, and the soil surrounding them is gradually frozen. In due course the freezing extends from one well to another, and the result is a solid block of frozen ground. Mining operations can be carried out in this frozen ground with perfect safety, the soil being excavated and the sides of the shafts being lined with cast iron or similar material. By applying this method, a number of shafts have been sunk, more particularly on the Continent, through soil which had defied all other means of sinking, and valuable coal measures, which would otherwise have been lost, have been opened up for exploitation.

In the manufacture of candles refrigeration is employed for keeping the wax in hot weather at a temperature at which it will set. It is, however, most largely employed in the crystallisation of paraffin as it is extracted from the oil shales.

During the process of distilling these shales a number of oils of different specific gravities are obtained; the more volatile oils are recovered in the ordinary way, but those oils which become solid at ordinary temperatures, and when mixed with stearine are so extensively used for candle-making, have to be crystallised by means of refrigeration. The object is to separate efficiently the paraffin from the oil, and this can only be done by allowing the paraffin crystals to grow to such a size that the oil will drain away from them. Even then a large quantity of oil is, owing to its viscosity, held mixed up with the crystals, and filtration has to be employed to separate it.

The trade in fresh fruits from abroad has been revolutionised by refrigeration, as instance the banana traffic from the West Indies, the fruit trade from the Cape, and the apple trade from Australia, Canada, and the United States. The dried fruit merchant has derived considerable benefit from the application of refrigeration. Goods such as dried figs, raisins, nuts, &c., upon which there was at one time a heavy loss due to the activities of insect life, are now placed in cold storage as soon as they arrive in this country. This keeps them in good condition and prevents the insects getting at them. Cigar manufacturers benefit in the same manner.

I will not weary you by going further into the application of mechanical refrigeration, and, though details can be furnished on application, as the advertisements say, I think it will perhaps be best to pass over lightly the services which it renders in mortuaries and in laboratories. In any case, I think I have said enough to point out to you its extraordinary value to manufacturers, and the high place which it is taking amongst the processes embodying the application of applied science to the benefit of mankind.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that until he heard the paper he had no idea that refrigeration could be applied to so many trades and processes. His only knowledge of the subject was connected with the meat trade, and he thought it would be of interest to the audience to know how important a part refrigeration played in the question of the food supply of the people. Although it had only been in existence for 25 years, refrigeration had been the means of supplying, in increasing quantities, cheap meat for the people of this country. For instance, in 1906 the amount of frozen and chilled meat imported was over 500,000 tons, 308,000 tons of which were mutton, lamb, and beef, 159,000 tons of chilled beef, and, most extraordinary of all, 40,000 tons of rabbits. In addition, there were imported, from the colonies only, 50,000 tons of butter and 100,000 tons of cheese. The industries connected with food were, he thought, probably the largest to which refrigeration could be applied, and certainly the most important to the people of this country, but from the many other trades mentioned by the author it was evident that it had a very wide field of application.

Mr. MATTHEW J. BROWN thought the author had presented in a vivid manner the extraordinary development of an industry whose growth was so recent that its beginnings were within the memory of most of those present. Until the various applications were brought together in Mr. Williams's paper, even one who was closely associated with the industry did not always grasp the wide application to which refrigeration could be applied. The author had shown, for instance, that it ranged from such a common thing as the penny ice-cream at one end of the scale, to the cooling of the blast used in great iron furnaces. Mr. Williams dated the beginning of the practical application of refrigeration to the introduction of the Bell-Coleman machine; and as he (the speaker) had the honour of being associated with Mr. Coleman when he was introducing that apparatus, he could look back with great interest to the time when the first cargo of frozen meat was brought across the tropics from Australia in the steamship *Strathleven* at the end of 1879 and the beginning of 1880. That was an epoch-making voyage, because from that small beginning had sprung the tremendous increase in the importation of food supplies to which the author had referred. He often thought that, if it had not been for the introduction of the refrigerating industry, the people in this country would be paying at the present day famine prices for their beef and mutton. He could not see how the country would have been able to raise the amount of meat necessary to give the population a good square meal.

Lieut.-Colonel CUNNINGHAM thought the chief interest of the paper lay in the fact that it drew the attention of the public to the vast field of the refrigerating industry, and the extraordinary variety of its applications. Although the industry was a new one, dating back only 25 years, probably the cause of its rapid development was that it had the effect of bringing into the country large quantities of cheap food. Its application to industries on a small scale were also of equal interest. One of its applications analogous to blasting was not mentioned in the paper. Blasting was ordinarily done with explosives, and one form of explosives was the violence of the action of expanding water. Water in freezing expanded slightly, bnt the small expansion was attended with great violence, and formed a very safe mode of producing an application of great force, whereby, for instance, stone could be broken up without the danger which arose when explosives were used. He desired to throw out one suggestion with regard to the application of refrigeration. Heat was applied in a practical way for the comfort of people by warming rooms by means of steam, hot water, and hot air pipes, but he did not know whether the cooling of rooms in hot weather had ever been tried on a practical scale. Attempts had been made in hot countries to produce this effect by placing blocks of ice round about the room, but while this had the effect of cooling the atmosphere in the vicinity of the ice it did not produce good results. He thought it might be possible to apply the circulation of brine or some cold material in pipes for the cooling of rooms. Although probably at first it would be an expensive process, it would certainly be productive of comfort, and he believed in time it would be cheap.

Mr. HENRY BRIER thought it would be of interest if he stated, in connection with the last speaker's remarks, that the rooms of a large hotel lately built in Bombay had been ventilated by means of cooled air being driven into them over brine pipes and with the aid of electric fans.

Lieut.-Colonel CUNNINGHAM stated that he was thinking of India principally when he made the suggestion. There was no doubt that it would be a great benefit to the British residents in India, in which country he lived for many years, if the rooms could be cooled in a moderately cheap and efficient manner. Twenty years ago, when he left the country, nothing of the kind was available, although passing the hot dry air of the hot wind through a screen of grass continually saturated with water produced an agreeable cooling effect.

Mr. R. M. LEONARD said that, although the author of the paper had referred to the commercial application of refrigeration in a wide sense, he did not

know that morgues and laboratories came under that category. One or two applications of refrigeration had been omitted from the paper; for instance, the large private establishment or mansion, in which gentlemen who kept up a large household found it paid them extremely well to keep a refrigerator for domestic purposes. Refrigeration had also had a great effect on the home markets, the retailer being able to buy his goods in times of glut and store them till the market rose. It had also been the means of raising the standard of living, and one of the great reasons why the industry had grown so rapidly was because it supplied large quantities of cheap food. He thought it would be found, if inquiries were made, that all industries which had developed so rapidly had been connected with some prime necessity of life. For instance, at the previous week's meeting of the Society Lord Montagu read a paper on motor 'buses, and as fast and cheap locomotion was an absolute necessity, the motor industry had naturally grown in a wonderful manner. The Chairman was probably in a better position than anybody to state how the refrigerating industry had added to the development of New Zealand and Australia, and it was undoubtedly the fact that nothing had so greatly aided the development of those colonies as the subject under discussion.

Mr. H. Carpmael said he had been struck with the marvellous ease with which refrigeration could be applied to a number of different things in the same building, it being only necessary to vary the temperature slightly to make it useful for various articles. For instance, wine could be kept at its proper temperature all the year round at the same time as fish or meat was being refrigerated, a fact which was amply exemplified in the hotels of the country. One application of refrigeration which was assuming considerable proportions, was the preparation of anti-toxin, which was prepared from a refrigerated solution of the dead bodies of the microbes to which Mr. Williams had referred. They were ground up by means of special machinery, and it was impossible to use the process unless the material was first frozen.

Mr. Arthur Williams said that the question of drying by refrigeration had interested him a good deal, and one of its applications which the author had not mentioned was that of efficiently thawing frozen meat. When frozen meat was taken out of a cold store and hung up in a butcher's shop, it had a large quantity of moisture deposited on it which spoilt its appearance; and a number of people had been endeavouring to devise means for thawing meat in such a way as to avoid the deposition of moisture. The ideal atmosphere which it was desired to attain was, he believed, that produced by a north-east wind, cold and dry. A number of processes had been brought out for that purpose, amongst them being an invention by the Chairman, which consisted in having a room fitted up with a series of freezing pipes set horizontally against the walls, and a series of steam pipes in the floor below a grating. That caused, without any mechanical appliance, a circulation of the air, the warm air rising off the steam pipes, and thawing the meat, afterwards depositing any moisture it had taken up, in the form of snow in the cold pipes, and continuing to circulate round and round. Meat was brought from the cold storage, where the temperature was from 20° to 25° F., and put into a room of such a temperature that no moisture would be deposited on it. That temperature was found to be somewhere about 45 degrees. The meat was kept for a certain time in that temperature, and then gradually raised to a temperature of 55 degrees, the highest practical point to which it could be taken. When the temperature reached 55 degrees, it was found there was a difference between the readings of the wet and dry bulb thermometers in the room of 10 per cent., showing a very considerable drying of the atmosphere. From start to finish, provided the temperature was properly regulated, there was no deposition of moisture on the meat. At the end of 48 hours, frozen mutton was found to be thoroughly and efficiently thawed, the same effect being produced in quarters of beef in four days. He believed those were approximately the times required to freeze the meat, so that the thawing appeared to be a reversal of the freezing method. Another application of the drying system of refrigeration mentioned by the author was that of drying photographic plates. In one factory with which he was connected it was found that one of the greatest troubles in drying in the ordinary way, by drawing in atmospheric air, filtering it through muslin, heating it up to 70 degrees, and passing it through the rooms, was the dust, which was not entirely eliminated by the muslin screen. To obviate that difficulty, a nest of refrigerated pipes were put in and a closed air circuit made. The author had said it was advisable to pass the air through a stream of cold water in order to eliminate the dust; but in working the refrigerated pipes he had mentioned, it was found that the moisture of the air was deposited on the pipes in the form of snow, and the dust appeared to be quite efficiently trapped in the snow, no trouble being experienced in the drying rooms from dust being deposited on the plates. Other applications of refrigeration could also be made in photographic plate factories. For instance, after the emulsion was made, it was put into small cooling chambers so as to cool rapidly and set; the plates were coated on a machine and passed over a slab which was cooled down by cold brine pipes, thus ensuring a quick setting of the emulsion on the plates.

Mr. Hal Williams, in reply, after thanking the speakers for the very kind remarks they had made, said that blasting by water which froze in the rock was very well known, in fact some of the alpine villages were more familiar with it than they cared

to be, because the freezing of water in crevices of rocks was the cause of a good many land slides and avalanches. The blasting effect produced continually frittered away the summits of mountains, and caused the constant falls of rock which took place. He was recently in an old chalk quarry the face of which he particularly remembered the last time he visited it was covered by vegetation, but he noticed that the whole of the face of the quarry was now perfectly white, large pieces of chalk having been blown off by the blasting effect of the ice. Mr. Brier referred to the Apollo Hotel, Apollo Bunda, Bombay, which was one of the most notable instances of the artificial reduction of the temperature of living rooms by means of refrigeration. That was the enterprise of the late Mr. Tata, a Parsee millionaire, by whom he was consulted some years ago as to the best means of cooling rooms. It was decided that the most efficient effect would be produced by blowing air over brine coils, and diffusing the air in at the top of the rooms. One of the great difficulties, however, of applying that system to any extent was, that no person could stand a sudden reduction of more than 10° without suffering from pneumonia or similar complaints. It was not safe for people living in a hot climate like India to suddenly go into a temperature which was reduced more than ten degrees. He had a curious commission a few years ago to design an artificially refrigerated summer house for an Indian Rajah, which was to stand in his grounds and act as a place of refuge for him on hot days, one of the principal stipulations being that a cupboard should be installed in the summer-house in which he could keep liquid refreshment cooled to a suitable temperature. Reference had been made to morgues and the preparation of anti-toxin by the grinding of the dead bodies of microbes; but he thought the less he went into such details the better the audience would be pleased, and he therefore passed over those matters lightly. Nevertheless, the use of refrigeration had had amazing results in that connection, and he would be pleased to supply any information on those topics to anybody who particularly hungered for it. Mr. Arthur Williams had referred to the cooling of photographic-plate rooms, and stated that he found snow on brine pipes perfectly satisfactory as an air filter. The reason why water was used to clean the air was that, when there was a stream of water falling down, every particle of air taken from the room and being blown by the fan had to pass through that water; whereas there were spaces between the coils, through which the air could pass without coming in contact with the snow. If the amount of snow on the pipes was very large, the area through which the air could pass was considerably reduced, and it had been found that the atmosphere most free from dust was obtained by blowing it through water; in addition there was the saving in latent heat if the moisture in the air was not frozen on coils. Mr. Arthur Williams also referred to the Chairman's invention for the de-frosting of meat. That was really another application of drying; in fact, he thought there was no doubt that it was the successful and novel method of drying air by freezing, which Sir Montague instituted in his de-frosting apparatus, and to which he drew attention in his patent, which first directed the attention of the industrial world to the great benefits which all sorts of processes could derive by drying with a low temperature in that way.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Hal Williams for his instructive and interesting paper, and the meeting terminated.

INEBRIETY AND INSANITY.

"I am satisfied that the majority of our insane inebriates have become alcoholics because of congenital defect or tendency to insanity, not insane as the result of alcoholism, and that the drunkenness which preceeded 'alcoholic insanity' was merely the herald —the only obvious sign—of incipient mental disorder." This sentence is taken from the report of the Inspector under the Inebriates' Acts, 1879 to 1900, a report that deserves the attention not only of magistrates and of others concerned with the administration of justice, but also of the Legislature.

Mr. Branthwaite's contention is that it is morally certain that many of the lunatics now in the asylums might have been prevented from becoming insane if they had been taken charge of when recovering from drunkenness, and properly treated earlier in their career. In the cases of insanity due to change in brain tissue the degeneration would not have occurred, and in those for which incipient brain disorder was apparently to blame, active development might not have supervened. Mr. Branthwaite asserts that mental incompetence stopping short of insanity holds a prominent position in the causation of habitual drunkenness, and that complete irresponsibility for drunkenness may result therefrom. The refractory persons sent to reformatories as inebriates are mentally unsound first and inebriates afterwards. "The physical demand for something to moderate restlessness and excitability, or cause temporary oblivion during the earlier stages of an attack of mad passion, accounts for their resort to alcohol. During an attack the same ungoverned impulse which prompts them to the committal of other unreasonable actions prompts them to drink madly regardless of results." If Mr. Braithwaite is right, the only possibility of an orderly life for such persons is total abstinence from liquor, a fact they have not the power to grasp, or if they do grasp it there are so many moments in their lives when insane impulse takes the place of thought and deliberation, that it is hopeless to expect improvement in conduct

unless preceded by improvement in mental condition. Such cases are almost hopeless when viewed in the light of possible reformability. Mr. Branthwaite says it is hardly realised how potent ordinary disease and ill health are in the making of inebriates. Impaired vitality lessens resisting power, and predisposition assumes unchecked sway.

Mr. Branthwaite gives many cases to support his thesis that very often habitual drunkenness may be due to abnormal physical conditions. For example: —Recently five women have been admitted to the reformatory suffering from advanced abdominal cancer. In each case experts to whom they were submitted for examination reported that the disease was of long standing, and, consequently, too far advanced for operative interference. The drunken history of these women does not go back more than an average of about three years, prior to which four of them held good characters as hard-working women, and there was nothing seriously wrong with the conduct of the fifth. These women attributed their drinking habits to "nipping," for the relief of pain and to remove the "sinking feeling" of "indigestion." Mr. Branthwaite has no doubt whatever that their drunkenness may safely be attributed to the pain and exhaustion of developing disease.

A woman described before her accident "as steady and plodding" was kicked on the head by a horse. Details are wanting as to the exact nature of her injury, but she was "unconscious for a long time, and for weeks afterwards was under treatment." When she had recovered sufficiently to go about by herself, she commenced a life of drunkenness, which soon brought her to the police-court, and ultimately to a reformatory.

Mr. Branthwaite contends that in very many cases which are treated by magistrates as ordinary offences against the law, for which fine or imprisonment is the proper punishment, the objectionable habits complained of are in no sense due to an effort of will, to a determination to get drunk after sane deliberation, but really to an absence of power to exercise judgment at all, or to the dictates of a warped judgment. Their actions are ungovernable because the mechanism provided for the purpose of government is out of gear, because the brain is so undeveloped, disordered, or poisoned as to be incapable of exercising anything beyond a mere semblance of control. Regarded as a remedy for habitual drunkenness, oft-repeated confinement in prison is, in Mr. Branthwaite's opinion, indefensible. "That such a course should ever have become established is evidence of old-time ignorance concerning the psychological and neurotic aspects of the question; that it should have grown to its present extent is partly due to the hard and fast doctrine of sin and punishment; that in face of all evidence of the uselessness, it still persists, is simply inexplainable. Its futility has been accepted for years past, and yet at the end of a century of exceptional progress, and at the beginning of another of greater promise, it still seems barely possible to look at a drunkard in a police-court without giving him "Five shillings or seven days."

Mr. Branthwaite's contention is that the repeated imprisonment of habitual inebriates not only neither cures nor deters, but makes the offenders worse than ever. Those who have had long experience in the treatment of drunkards, know that it is necessary to give drugs and careful medical attention during the period of recovery from a drinking bout, to prevent the shock and harmful effects of a sudden discontinuance of liquor. "When hundreds of drunkards are sent to prison every week, individual attention to the extent necessary to avoid shock is impossible. It is, therefore, more than probable that repeated arrest, with its sudden discontinuance of liquor, will in the end produce permanent injury to brain and nervous organisation. If the prison system neither cures nor deters, does it afford reasonable protection to the community? In Mr. Branthwaite's opinion is does not. The intervals of dangerous liberty are too frequent for any public advantage to accrue. Unless therefore we are prepared to admit that the process of imprisonment for short periods is solely one of retaliative vengeance, it is useless, and because useless, an absolute waste of public money. If this be a correct diagnosis, then many insane inmates have been punished for years as sane criminals, being thrown into prison with monotonous regularity simply because their ravings were intensified by drink or mistaken for drunken disorder, and many others definitely imbecile and epileptic have met with similar treatment merely because drunkenness happened to be the most prominent symptom, and because the exact condition was so masked by inebriate habits as to be impossible of diagnosis by non-medical administrators of justice.

What then is the remedy suggested? In Mr. Branthwaite's opinion the main points which call for attention and amendment are the delayed committal of inebriates to reformatories, and the unsatisfactory nature of their previous treatment. It is heart-breaking, he says, to watch the admission of one case after another, each bearing the stamp of hopeless irreformability, and know that the result is a foregone conclusion—because no earlier effort has been made to reform. Mr. Branthwaite asks whether prison cannot be avoided altogether in the majority of cases, and he refers with approval to the suggestion of a well known stipendiary magistrate. Instead of holding the threat of prison over habitual drunkards, and inflicting fines which sooner or later mean prison, he suggests that the possibility of being sent to reformatories should be kept before them from the first, and that each conviction as it occurs should be looked upon as a step towards that end. The first conviction under such a scheme would mean a discharge with a caution; the second would be similarly treated, with the additional information to the prisoner that one step nearer committal had been reached; the third conviction, bound over to be of good behaviour; and the fourth, within the year, committal to a reformatory. Such a

course would provide the managers of reformatories with better material, would give the prisoner a real chance of reformation, and would be economic in every sense of the word. The routine of a prison is no more suited to the needs of an habitual drunkard than it is suited to the treatment of any other form of mental unsoundness. He requires care and control on looser lines, something more individually suited to his temperament than the cellular solitude to which he is subjected during short sentences.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admtralty in December, 1906 :—

New Charts.—34—England, South coast :—The Scilly isles. 3601—Scotland, west coast :—Loch Dunvegan, including Loch bay. 2582—Orkney islands :—Pierowall road and approaches. 3578—Spain, south coast :—Eastern approaches to the strait of Gibraltar. 337—Canada, Lake Ontario :—Toronto harbour. 1313—Chile; the channels between Maullin bay and port Montt. Plans :—River Maullin, port Abtao, port Montt. 3594—British Columbia; plans on the east coast of Vancouver island :—Ganges harbour and Captain passage; Porlier pass. 69—Ceylon :—Pámbam pass. 3615—Plans in the Philippine islands :—Santa Cruz harbour; port Banalakan; port Boca Engano. 905—Philippine islands :—Ports Masinlok and Matalvi and Palauig bay. 3588—China :—Canton river delta. China, north coast :—Kyau chau bay to Lai chau bay. 913—Korea, west coast :—Mackau group to Clifford islands. Plan :—Ochon to anchorage (Palos harbour). 3114—Japan :—Izumi and Simonoseki ko. 8566—Japan : — Izumi Nada and Harima Nada. Plans :—Yura ko; Sumoto ko; Kata Seto.

New Plans and Plans added.—633—Harbours and anchorages on the east coast of Ireland. New plan :—Malahide inlet. 2063—Malta island, northern portion. Plan added :—Ras in Nieshfa bay. 708—Anchorages on the west coast of Madagascar. New plans :—Nosi Mitsio (Minow islands); Ampasimena (Diamond) bay. 944—Ports in the Philippine islands. New plan :—Port Batan. 991—Anchorages on the coast of Yezo island. New plan :—Kushioro road. 3409—Japan :—Ishinomaki wan (Sendai bay) and Sakata ko to Tsugaru Kaikyo. Plan added :—Obato wan. 210—Japan :—Harbours on the east coast of Nipon. New plan :—Yamada ko. 1648—Japan :—Osumi Kaikyo (Van Diemen strait) to Oshima. Plan added :—Osumi group. 3340—Gulf of Tartary, northern sheet. Plan added :—Sertuna river anchorage. 845—Fiji :—Kandavu passage to Kowata island. Plan added :—Likuri island anchorage. 1386—Islands in the south Pacific ocean. New plan :—Cook bay or Hanga road.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners : — 1967 — England, south coast : — Plymouth sound. 2978 — Iceland : — Sigle fiord to Niardvig. 2172—Alaska: —Bering strait. 2908—Africa, south coast :—Port Natal entrance. 2062—Cochin China :—Ton king gulf. 3349 — China :— Approach to Kwang chau wan. 1055—Korea :—Southern approach to Ping Yang inlet.

These charts are issued by Mr. J. D. Potter, 145, Minories.

RUSSIAN STEAMSHIP SUBSIDIES.

Russia seems determined to do all in her power to revive her Oriental trade, and to advance her commercial interests in the Eastern world. To this end, she has been systematically at work granting subsidies to lines of steamships plying between her own ports and those of China, Japan, and other ports of Asia. Contracts have been made this year by the Russian Government for subsidised steamship services from Vladivostok to ports of China and Japan, and also along the coast to Nikolaievsk, Petropavlovsk, and other ports. The contract for the China and Japan lines, is for one year, and was given to the Russian East Asiatic Steamship Company, which is closely connected with the Danish East Asiatic Company. It provides, first for a weekly mail and passenger steamer from Vladivostok to the Japanese port of Tsuruga, which lies to south-east on the Japan Sea. This trip, according to the American Commercial Agent at Vladivostok, is scheduled to be made in thirty-eight hours, and from Tsuraga, Kobe and Osaka can be reached by train in eight hours, and Tokyo in fourteen hours. Secondly, for a weekly mail and passenger steamer from Vladivostok to Shanghai, *viâ* Nagasaki, and back by the same route. The voyage from Vladivostok to Nagasaki, takes about fifty hours, and the whole run to Shanghai about four days. Thirdly, for a freight and passenger line from Vladivostok to the ports of Gensan, Fusan, Nagasaki, Chemulpo, Shanghai, Chefoo and Dalny, and return, sailings to be once in two weeks.

It is provided that the speed of the mail and passenger steamers must not be less than thirteen miles an hour, and of the freight and passenger steamers not less than ten miles an hour, and it is stipulated that the sailings must be timed to provide good connections with Russian and foreign railway and steamship lines as the Russian Government may direct. The chartering of foreign steamers is allowed. Mail steamers must have accommodation for eighty first-class, and three hundred third-class passengers, and a cargo capacity of 1,500 tons. Th e freight

steamers must accommodate twenty-five first-class, and two hundred third-class passengers, and be able to carry 1,500 tons of cargo. Russian mails, and mails from foreign ports, for Russia, are to be carried free, as well as the postal clerk to sort them, but the clerk is to be charged half the regular rate for his board. When so ordered by Russian diplomatic or consular officers, the vessels must carry free, Russian subjects found abroad in a destitute condition, but not more than five on each steamer. Freight and passenger rates are not to exceed a maximum approved by the Department of Commerce and Industry. For delay in departure or arrival, the mail steamers are subject to a fine of £5 an hour, and the freight steamers to a fine of £2 12s. an hour. If the delay is caused by inopportune acceptance of cargo, or by touching at a port not indicated in the schedule, the fine is to be doubled. For leaving a port before the scheduled time, a fine of £100 is to be imposed on the mail steamers, and of £50 on the freight steamers. The fines for omitting the whole, or part of a voyage, are respectively £500 and £250 for the two classes of steamers. If delay is due to fogs, storms, lateness of express trains, or other reasonable causes, no fines are to be imposed. Moreover, if on account of late departure from one port, the sailings from succeeding ports should also be delayed, only one fine is incurred. If the company fails twice to complete a voyage, the Government may cancel the contract, transfer the business to another company, impose a fine of £5,000, and cancel all obligation of the Government to the company.

The Russian East Asiatic Steamship Company also has a contract for a coasting line between Vladivostok and Nikolaievsk, with stops at six ports each way. Fourteen voyages must be made during the season. A speed of ten miles an hour, and a cargo capacity of 1,000 tons are required for the vessels employed, which may be under a foreign flag. Maximum freight and passenger rates are fixed, and it is provided that troops shall be carried at half rates. Government mails and couriers are to be carried free. Fines are to be imposed of £25 for a day's delay in arrival at, or departure from a port; of £50 for leaving port before the appointed time, or from omitting any port; of £150 for omitting a voyage or any part of it, and of double the amount for a second offence. The subsidies to be paid to the Russian East Asiatic Steamship Company for all these services, have been kept secret, but it is said that they amount to about £75,000 for the year. A third contract has been made with the Russ Steamship Company for a line from Vladivostok to the ports of the Okhotsk and Behring Seas, the Commodore Islands and the Chukotsk Peninsula. The steamers must have a speed of not less than eight miles an hour, and a cargo capacity of not less than 1,000 tons. Foreign steamers may be used. The subsidy in this case is fixed at £21,500 for the four voyages to be made this season, including one trip from Petropavlovsk to the mouth of the Anadir River.

HOME INDUSTRIES.

Telephone Extension.—It is often said, and not without justice, that the United Kingdom is much behind other countries in the use of the telephone. Elsewhere the telephone service is a good deal cheaper, and its use much more general. But even in England its use is rapidly extending, as is shown in the particulars given by the National Telephone Company in its report upon the business of the half-year ended December 31st, 1906, just issued. The report shows the growth year by year of the business of this great company. In 1904 its income was £738,680, and the amount of the rentals carried forward for unexpired terms, £313,979; for 1906 the figures had risen to £2,436,996 and £1,057,806 respectively. The Post Office royalties in the former year were only £67,223, in the latter they had increased to £231,848. Practically the company doubles its income every seven years. During 1906 no less than £1,129,970 was expended on capital account in the erection of additional exchange and private stations, and in the construction of underground works, the corresponding expenditure for 1905 being £974,849. The official statement is that the the new expenditure to be incurred during the next five years is to be a reproductive one, and the future policy of the company will be to spend no money on capital account which is not of this class, and "only that which will earn sufficient to pay interest and all proper charges, and yet be worth in 1911 what it will then stand at in the books." This policy is, it may be assumed, unavoidable having regard to the Company's limited tenure, much as it may be regretted in the general interest. The field for the extension of the service is immense.

Brewery Companies.—The announcement in the King's Speech that a Licensing Bill is being prepared by the Government (a Government supposed to be less friendly to the brewing interest than its predecessor) was not calculated to make investors more ready to buy brewery shares. For many years the stocks of brewery companies were among the most popular as investments, but of late, and more especially since the Licensing Act of 1904, which, under the compensation fund clause, is said to mulct the brewery companies of something like 1 per cent. on their capital, the investor has looked askance at this form of investment. For several years past the public have not been invited to subscribe to new brewery companies; and such amounts of new capital as have been offered by existing companies have mostly been subscribed for by the shareholders in the companies. There has, too, been steady depreciation in brewery stocks, partly due to the fear of further legislation inimical to the brewery industry, and partly to the general belief that the people are drinking less, and yet the profits of the brewery companies are not, speaking generally, diminishing to any serious extent. The necessary result has been a considerable increase in the net return to the investor, which now

ranges from 6¼ to per cent. to 9½ per cent. The *Economist* takes the accounts issued within the past two months of a number of brewery companies operating in different parts of the country, to show how the profits and dividends of the past year compare with those of the previous twelve months; and also how current prices and yields compare with those of a year ago. Taking fourteen representative English companies, the net profit earned by them in 1905 was £536,752, as against £525,698 in 1906, when brewery materials were a little higher than in the preceding year. The yield at the present time on many brewery stocks is exceptionally high, high enough, as it would seem, to make ample allowance for such depreciation as may arise from legislative interference with the brewing interest, and the falling off in the consumption of alcoholic liquors, consequent upon the smaller consumption per capita.

Solidified Tar.—A process has recently been patented for solidifying tar which promises, it is reported to be a commercial success. There is said to be only a loss of from 4 to 5 per cent. of the total material employed, and the product, if expert calculations are to be relied upon, is produced at much less than the cost of pitch. The inventor has sought to render tar more readily portable, and to make it applicable, at reduced cost, to many commercial uses to which at present liquid tar is unsuitable, such as replacing pitch in the manufacture of briquettes, road making, and water proofing. The process will enable a gas company to recover the more valuable portions of the tar, namely crude, naphtha, and light oils, and these can be further treated for the manufacture of carbolic acid, or used for enriching the gas made. The remaining tar can then be solidified by the patented process, and the finished material be sold locally at better prices than is obtainable for the crude tar. The cost necessary for the process is simple and inexpensive, much cheaper than the ordinary distilling plant, and quicker in operation, the whole process being complete in one day. Again, it is thought that the solution of the motor problem traffic will be assisted by this process. It is only possible to thinly surface a road with liquid tar; even boiling tar will not penetrate the surface of a road to a greater depth than two or three inches, but by the employment of solid tar blocks made by the process under review, a substantial depth may be obtained. The process enables the tar to be used in a granulated form, mixed with sand, shingle, or cement chips, and forms, when heated and pressed, a material said to be second to none for wearing surface, quite acid proof, and non-slippery. If, as is claimed for it, the solidified tar can be sold at a price that will leave a fair profit, it may be expected to have a considerable sale.

The Rubber Trade.—Although the world's supply of india-rubber in 1906, nearly 65,000 tons, mostly went into consumption, and manufacturers were busy throughout the year, largely owing to the increased demands of tyre-makers, the price of fine grades of Para, Bolivian, and Peru, showed a slight decline. No new areas of supply of much importance were opened up. The supply from the West Coast of Africa showed little change, being about 17,200 tons, as against 17,500 in 1905. Nor has there been any increase in Central America and Mexico supplies, although joint stock enterprise has turned its attention to Mexico, where, however, the Americans are said to have secured control of the most promising rubber districts. Messrs. S. Figgis and Co. give the total imports into the United Kingdom of all sorts as 21,269 tons. If these figures are correct, and Messrs. Figgis and Co. are authorities upon the subject, the imports of rubber into the United Kingdom were less last year than in 1905—21,269 tons as againstz 1,700 onst. In his book on "The Cultivation and Preparation of Rubber," Mr. Johnson gives the importation as far back as 1900, as 25,664 tons. However that may be, imports are less large than might be expected, having regard to what would seem to be the rapidly increasing demand for rubber.

Tax on Commercial Travellers.—It is not perhaps surprising that considerable irritation has been shown in this country in consequence of the imposition of the Quebec Commercial Travellers' Tax. It has, of course, to be remembered that this tax is a provincial one, not one that is the outcome of Dominion legislation. But this distinction is not appreciated by home critics. It is argued to be an anomalous state of things which permits a Government part and parcel of the British Empire to tax British commercial men visiting Canada with the one object of doing business there. Referring to the subject in his report to be found in the weekly report issued by the Government of the Dominion, Mr. Harris Watson, who is the Canadian commercial representative in London, says that "quite a few firms have stated that they are instructing their agents to avoid the Province of Quebec altogether, and almost all complain that in their estimation taxes of this description form an obstacle to the development of Anglo-American trade." It is to be regretted that the Quebec Legislature has thought it necessary to impose the tax as against the mother country. The yield from it must be insignificant, whilst the irritation caused by it is considerable.

Exports of Manufactures and Yarns.—Messrs. Helmuth Schwartze and Co. give a condensed statement of the British export of woolen manufactures and yarns, which shows in the period under review—1895-1906—an increase of nearly 10 per cent., of which about 7 per cent. was due to larger quantities, and 3 per cent. to higher values. The total is the best since 1874. The increase went principally to Germany, Australia, Canada, and South America, while China, Japan, and the United States, took took a little less.

The Carpet Trade.—There is a general impression that the British carpet trade is a decaying industry, but in its commercial history and review of 1906 the *Economist* shows that this is a mistaken view. No doubt manufacturers have been heavily hit by reason of the greatly enhanced values of all raw materials, and it is an open question whether they have even covered the cost of production, but the volume of trade was equal to that of 1905. The carpet industry is always one of the last to share in the benefits of national prosperity, as it is one of the first to suffer in periods of depression, but there was a marked expansion in the Colonial and South American demand, which compensated for the quietude, and at the end of the year there was a distinct revival in all the home centres. The Axminster trade has been the most active, but there has been a growing demand for super Wiltons. Brussels carpet remains out of favour, fashion having shifted to deep cut pile carpets, but it is thought there may soon be a revival in the demand for Brussels, and the lower grade Wiltons, said to be the most durable floor covering on the market. Unfortunately, the Axminster manufacturers have had to reckon with something like an advance of 50 per cent. in the raw materials whilst unable to raise the price of their various grades. The export trade has been good. The trade with the United States has improved, and Canada, Australia, the Argentine Republic, and Mexico have been good customers. On the Continent little has been done, and the new Spanish tariff precludes the hope of any improvement in dealings with Spain. The Canadian preference should enable English makers to improve trade with the Dominion at the expense of their German and French competitors, and the *Manchester Guardian* states that three English firms have decided to start mills in Canada.

OBITUARY.

THOMAS WHITE SMITH.—Mr. Thomas Smith, for many years the principal of the Caslon Letter Foundry, died on the 5th inst. after a severe attack of influenza. He was the son of a Wesleyan Minister, and was born at Tiverton in 1835. After six years' schooling at Kingswood, near Bristol, he was apprenticed to a printer at Newport, Isle of Wight. In 1851 he was at a newspaper office in Guernsey, where he obtained the testimonial that he was "a swift and clean compositor." After various changes he obtained, in 1857, an engagement in the counting house of the Caslon Letter Foundry. In 1865, through Mr. H. W. Caslon's dispute with his *employés*, business was suspended for eight months. Mr. Smith, in consequence, became manager of the new London branch of Messrs. Stephenson, Blake and Co. In 1873 he took charge of the Caslon Letter Foundry owing to the illness of the proprietor, Mr. H. W. Caslon. On the latter's death in 1874 he became a partner in the firm, and in the following year started the "Caslon Circular," in which for twenty-one years he wrote almost everything that appeared. In 1895 he became sole proprietor of the historic Caslon Letter Foundry. He withdrew from active partnership in 1900, and left the business in the hands of his sons. Mr. Smith was elected a member of the Society of Arts in 1880.

GENERAL NOTES.

EXHIBITION OF PERIODICALS.—An International Exhibition of Professional Newspapers and Periodicals will be held in the Exhibition Hall of the Society of Industrial Arts in Copenhagen, in May and June next, under the presidency of Sigurd Berg, Minister of the Interior. The Exhibition is promoted by the Association of Danish Professional Papers and Periodicals. The office of the Exhibition, from which information may be obtained, is Colbjprussensgade 14, Copenhagen.

MEXICO.—In his review of the trade of Mexico for 1905-6 (Cd. 2682), Mr. Reginald Tower gives figures showing an increase in the imports of no less than £4,250,000, or 23·82 per cent. on the value of the imports in the previous fiscal year, but he points out that nearly the whole of this increase arises from the imports of minerals. In most of the other branches, trade only shows a normal growth, while in the classes of machinery, dry goods and arms, explosives, &c., there was a slight falling off. The immense increase in the value of minerals imported arose from exceptional and non-recurrent circumstances, being almost entirely due to the importation of the gold coins minted in Philadelphia, and of gold in other forms, with the object of establishing the gold standard, and is counterbalanced by the corresponding increase in the amount of Mexican dollars exported in exchange. It may be noted that the product of the guayule tree figures for the first time among the exports. It is a form of cactus extract used in considerable quantities for mixture with rubber. An export tax was imposed on it in the Budget Bill, 1906-7, and it is expected that with the great demand for rubber throughout the world, the production of guayule will have considerable development.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

FEBRUARY 27.—"Modern Typewriters and Accessories." By ARTHUR E. MORTON, Examiner in Typewriting to the Society of Arts. SIR JOHN CAMERON LAMB, C.B., C.M.G., will preside.

MARCH 6.—"The Discovery of the South Eastern Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S. The Right Hon. LORD HARRIS, G.C.S.I., G.C.I.E., will preside.

MARCH 13.—"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc.

MARCH 20.—"Smoke Prevention in Factories." By JOHN B. C. KERSHAW, F.I.C.

Dates to be hereafter announced:—

"The Underground Water Supply of the Thames Basin." By CLAYTON BEADLE.

"Hungarian Arts, Home Industries and Commerce." By LOUIS FELBERMAN.

"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon.

"Aerial Navigation." By MAJOR B. F. S. BADEN-POWELL.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras. The LORD AMPTHILL, G.C.S.I., G.C.I.E., will preside.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States. SIR FRANK SWETTENHAM, K.C.M.G., will preside.

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. HALSEY RICARDO will preside.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

February 25; March 4, 11.

LECTURE I.—FEB. 25.—What Romanesque is—French examples—Oriental features—The portals at Chartres—Provençal developments—Direct Oriental influence in France and Italy—Norman Romanesque—Tau croziers — Fonts imported from Tournai—Sicilian Romanesque — The zig-zag—Scandinavian patterns—Spanish churches of 9th and 10th centuries.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, FEB. 25...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lectures.) Mr. F. Hamilton Jackson, "Romanesque Ornament." (Lecture I.)

Farmers' Club, Whitehall Rooms, Whitehall-place, S.W. Dr. J. A. Voelcker, "The Fertilisers and Feeding Stuffs Act (1906.)"

Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Aubrey J. Spencer, "The Agricultural Holdings Act (1906.)"

Geographical, Burlington-gardens, W., 8½ p.m. Mr. George G. Chisholm, "Inland Waterways."

Actuaries, Staples-inn-hall, Holborn, 5 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, FEB 26. Royal Institution, Albemarle-street, W., 3 p.m. Professor W. Stirling, "The Visual Apparatus of Man and Animals." (Lecture III.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. Dugald Clerk, "The Limits of Thermal Efficiency in Internal Combustion Motors."

Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, FEB. 27...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Arthur E. Morton, "Modern Typewriters and Accessories."

Geological, Burlington-house, W, 8 p.m. 1. Mr. William George Fearnsides, "The Lower Ordovician Succession in Scandinavia." 2. Mr. Cuthbert Baring Horwood, "The Occurrence of Pseudomorphous Pebbles of Pyrites at the Crown Reef Mine (Witwatersrand)."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

THURSDAY, FEB. 28...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. W. Martin, "Old Dutch Paintings and Painters." (Lecture I.)

Optical, 20, Hanover-square, W., 8 p.m. Annual meeting.

FRIDAY, MARCH 1...Royal Institution, Albemarle-street, W., 9 p.m. Count de Bosdari, "Dante in the Critical and Poetical Works of Carducci."

SATURDAY, MARCH 2...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Röntgen, Cathode, and Positive Rays." (Lecture III.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 4, 8 p.m. (Cantor Lecture.) F. HAMILTON JACKSON, "Romanesque Ornament." (Lecture II.)

TUESDAY, MARCH 5, 4.30 p.m. (Colonial Section.) SIR WILLIAM HOOD TREACHER, K.C.M.G., "British Malaya."

WEDNESDAY, MARCH 6, 8 p.m. (Ordinary Meeting.) PROF. W. BOYD DAWKINS, D.Sc., F.R.S., "The Discovery of the South-Eastern Coalfield."

Further details of the Society's meetings will be found at the end of this number.

EXAMINATIONS.

The Society's Examinations will commence on Monday, April 15.

The last day for receiving applications from Local Committees is Tuesday, the 12th March, 1907, and after that date none will be received under any circumstances whatever. Application forms from the Provinces should therefore be posted not later than Monday, the 11th March. Committees may, however, close their entry lists at an earlier date, if found desirable.

Copies of the Programme for 1907, with full details, together with the questions for 1906, and reports by the Examiners, can be had, price 3d. (post-free 4d.) on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C.

The questions for the years 1900, 1902, 1903, 1904, and 1905 can also be obtained (price 4d. each year post-free) on application as above.

CANTOR LECTURES.

On Monday evening, February 25th, Mr. F. HAMILTON JACKSON, Vice-President of the Society of Designers, delivered the first lecture of his course on "Romanesque Ornament."

The lectures will be published in the *Journal* during the summer recess.

CANTOR LECTURES ON ARTIFICIAL FERTILISERS.

The Cantor Lectures by Mr. A. D. Hall, M.A., Director of the Rothamsted Experimental Station, Lawes Agricultural Trust, on "Artificial Fertilisers: their Nature and Functions," have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, February 14; THE RT. HON. LORD CURZON OF KEDLESTON, G.C.S.I., G.C.I.E., in the chair.

The CHAIRMAN, in opening the meeting, said that although he was at present taking no part in public affairs, he could not resist the invitation, which he regarded almost as a command, to be present and introduce the reader of the paper. Sir Frederic Lely was one of the most eminent civilians who had served the Government of India in recent years, distinguished both by the eminence of the posts he had filled and by his notorious sympathy for the people. Rising through the various grades of the Bombay Administration, he was Commissioner at Ahmedabad at the time the terrible famine of 1899-1900—about which he was chiefly going to speak—fell upon the rich province of Gujerat, of which he was the head. How Sir Frederic administered that famine the audience would be able to gather from the paper, modest as it was certain to be, that would be read. It was partly in recognition of his work in that famine that he (Lord Curzon) had the pleasure of inviting him to be a member of the Legislative Council at Calcutta, and later, before the termination of the author's career in India, he made him the head of the Central Provinces. Such were the record and the credentials of the distinguished man who was to read the paper.

The paper read was—

THE PRACTICAL SIDE OF FAMINE IN INDIA.

By Sir Frederic S. P. Lely, K.C.I.E., C.S.I.

As the subject of Indian famine has been already treated on two occasions before your Society, I wish to make it clear that I make no pretension to occupy the ground already covered by the ability and knowledge of Sir Charles Elliott and Mr. Holderness. I only take up the subject because my point of view is different from theirs. They discussed the broad problems of famine policy as they appear from the watch-tower of the Imperial Government. I essay the humbler task of giving some reminiscences of one who was down below in the thick of the fight. Anyone who makes a study of, for example, the great Mutiny, its causes, progress, and results, will, of course, go first to the comprehensive pages of Kaye and Malleson and others, but he will be all the wiser if he adds to his reading such books as the narratives of Lady Inglis and Sergeant Forbes Mitchell. And so I venture to hope my words, though limited in their scope, may have their use in bringing home to you the anguish of famine.

We often hear of invasions of India over the North-West Frontier—of how successive hordes of foreign soldiery have poured down upon its plains to conquer or destroy. But perhaps it is not realised so clearly by those who have not lived in the country that every year there is an overwhelming invasion from the south, which is not feared but welcomed, for it brings not havoc and death, but food and courage to an exhausted land — it brings water, which, in a tropical country, more than wine, "maketh glad the heart of man." The Hindu, who deifies everything, would say it is the advent of the storm-god Indra, "whose mantle is the sky, whose jewels are the stars, whose chariot is a cloud, and who rides on the wings of the south-west wind." The matter-of-fact Englishman is content to call it the monsoon wind driving the moisture-laden clouds over the land, from the southern sea. You will forgive me if, in order to round off my story, I briefly recount what happens, though to many it must be already familiar. After the month of September, there is little rain in the centre and north of India, and after March the land becomes intensely hot. This rarifies the atmosphere, and thus a current of wind, laden with moisture from the sea, is drawn in and gradually established, from south to north. It breaks first upon the island of Ceylon, and thence passes on to strike against the Ghauts, where the colder temperature of the hill sides condenses the vapour into heavy rain. At first, the mountain range is too high to be surmounted, and so the clouds pass on northward, leaving the greater part of the Madras Presidency, to the east, high and dry. As the mountains get lower, they spread to the other side. The valleys of the Tapti and Narbadda are gateways through which offsets pass into the centre of India, but the main body pours itself over Gujerat, one of the garden provinces, and onwards, over the dry plains of Rajputana into the north, where its advance is blocked and diverted by the great barrier of the Himalayas. Sindh is left out altogether. No rain falls there throughout the year except occasional showers, and the province would be a desert but for the Indus, which, in the heat of the month of March is flooded with melted snow from the hills, and spreads itself over the country in a network of canals. What the Nile is to Egypt the Indus is to Sind. But Nature's programme is not yet finished. We left the remaining mass of rain-cloud banked against the Himalayan Mountains, where it is finally exhausted in rainfall, making fertile fifteen hundred miles of country up to the jungles of Assam. But a large corner was left aside by the incoming monsoon, and the rest of India being now supplied, a wise and beneficent Providence completes its scheme by arranging for that. A reverse action begins. As the sun goes south in the latter half of the year, the land of Upper India becomes cooler, while the sea retains much of its warmth. Consequently, a backward current of wind is created, and that portion of it which passes over the Bay of Bengal absorbs moisture from it, which is precipitated on the fields of Madras. If everything is normal, it goes almost like a well-managed railway system. I lived for some years in the city of Ahmedabad, and we used to look out there, towards the end of May, for news of the arrival of the monsoon in Ceylon, and when it came, we expected the rain at our own gates in just about three weeks. In many years, however, there is some little hitch, some deflecting influence which we cannot, at present, understand or foretell, which upsets the distribution and causes too much rainfall here, and too little there; a flood here, and a drought there.

Now, every one who has lived through the

year in the plains of India must have a vivid memory of that time of suspense, at the end of the hot weather, when the world is waiting for the rain. For the last three or four months the pitiless sun has been beating down on the land turning it all to a monotonous brown—scorching, cracking, pulverising. The hot wind, like a blaze, has been whirling the dust into every wrinkle and crevice. Outside, every stone is too hot to touch; inside the tent-or house—even the chairs and tables, covered with grit, feel to the hand like the floor of an oven. The mosquito has become a burden, and the cattle peering about in the withered fields for their daily food grow weaker and thinner. The whole of Nature gasps. Men whisper to their neighbours, "When will Meghji (the rain-god) come? Has he reached Ceylon? What news from Bombay"? When he does come, especially after being long delayed, a sigh of relief goes round as men realise that once more the great crisis of the year has been passed. There is no better music on this earth than the splash of the rain, and the running of the gutters after a prolonged hot season. Sometimes it does not come, and then we have, enacted on the stage of real life, the tragedy of famine.

We hear much of approximation between East and West, of the sympathy which ought to exist between Englishman and Indian. Many look to social intercourse as a means of obtaining it, and they are right, so far as they go. But I have chosen the subject of this paper in the belief that if we could enter into the monsoon experience of our fellow-subjects—into that if no other—we should get nearer to them than by months of superficial contact. It has exercised as deep an influence upon their life and character as, *e.g.*, our insularity has upon ourselves. The frequent want of what we call pluck, so often remarked in the Indian, may be partly explained and excused by it. The vigorous Anglo-Saxon belief that man is master of his own fate, sounds a mockery to people whose very existence depends every year at a certain season on the coming of a wind that bloweth where it listeth. Until the British Government came and took famine by the jaws, there was nothing for the humbler and weaker Indian, on a failure of rain, but to sit down and die, as he did every other year in one part of the country or another under native rule. It is little wonder if the cumulative effect of many such failures has been to diminish self-reliance and power of initiation.

However, that is by the way. Before the year 1899, in the province of Gujerat, to which I wish particularly to invite your attention, the people were generally well fed, and lived in comfort, on a fertile soil. Including minor Native States, the area is nearly 34,000 square miles and the population about 5½ millions—considerably larger in both respects than Scotland, though only a fraction of the great famine tract under the Government of India. It is recorded that in the two years 1828 and 1829, part of the Government share of the land-rent was remitted, not because of the failure of the crops, but because of their abundance, in consequence of which, and the impossibility of conveying to distant markets, grain was unsaleable except at nominal prices. When I first knew the province the effects were still visible of the inflated prosperity of the time of the American War, when the price of country cotton went up from fourpence per pound to two shillings, and when cultivators, having no use for their unwonted wealth, had the clamps and tyres of their field carts made of silver, or indulged in the luxury of an extra wife, or employed labourers instead of working with their own hands. They had to suffer when the reaction came and found them with a higher standard of expenditure and reduced incomes, the consequence of which was general indebtedness, but still the poorest had enough to eat, and the masses more than enough. Men who came from other parts of India were struck with the well-fed and indolent Gujeratee as compared with the frugal and laborious Maratta. I remember the amusement of an Indian gentleman, who had come from the Deccan to live in the town of Broach, at finding that many of the lower classes required their early morning tea. There had been no serious famine among them for a century, and they only knew of it as a grandfather's tale. To such a people it was a terrible shock, when in 1899 the month of June passed into July and that again into August with practically no rain. It came up the coast as far as Bombay, and then under some occult influence it dwindled off into casual showers, leaving the great region of Central India down to the west coast to lie as a desert, instead of, as it usually was in July, a green garden.

With one consent the eyes of all were turned to their first line of defence—the gods. Wealthy men employed Brahmins to say prayers in the temples. Parties of women day by day drenched the emblems of their favourite deities with

water, to indicate in the clearest possible way what they wanted. The mayors of the chief towns walked in procession round the walls, stopping at every gate to pour out libations of milk, and winding up with that most indispensable of religious ceremonies, a feast to Brahmins. In the villages, on a fixed day, the people left their houses in a body and cooked their food in the fields outside. The significance of this I take to have been that the rain-god apparently desired to lay waste the land, and it was hoped he would accept the deserted village as a substitute. "You wish to make bare our fields, take our empty houses instead."

By the end of August the people began to realise it was all of no avail, and to turn their eyes to their last hope—the officers of the British Government. Already the first sign of approaching calamity had made itself visible, viz., wandering people and wandering cattle. It may sound cynical, but it was as important to save the cattle, as to save the men and women, for on the former depended the future livelihood of the latter. The cultivator's plough and cart were drawn by oxen only. The cows supplied even the poorest with whey, if not with milk, which was the only form of animal food permissible in a country where eating meat is a sin. It was pitiful to see the frantic efforts of the poor folk to save their cattle. They searched about in the corners, and on the waysides, for straws and sticks—anything that could be masticated. They tore the thatch from the roofs of their houses. They climbed the trees, and picked off the leaves one by one, so that to the brown fields, and hungry vagrants, and wandering cattle, was added yet another presage of mighty famine, viz., lines and groves of skeleton trees stripped of their green foliage. The official weekly return of deaths was compiled by clerks, whose knowledge of English was often rather scanty, and about this time, in the column of "Causes of Death," there appeared a new disease, called "trefal," which was puzzling until it occurred to one that it was meant for tree-fall, and referred to unlucky persons who had climbed in search of leaves for fodder, and had missed their hold and fallen. Every week, for more than a month, "trefal" continued to account for three or four deaths—the first victims of the famine that was now closing its grip upon us. We were face to face with a series of grave problems. There were roughly two million head of cattle with practically not a blade of grass nor a wisp of hay to feed them on. For it was not the custom of the country to store hay. So secure did the people think themselves that those who happened to have a surplus in the month of June sold it off for export, to their bitter regret a month or two afterwards. With the railways at command it was comparatively easy to bring in grain to feed the people, but to supply the needed grass was not so easy seeing that every full grown animal would eat up two truck loads before the rainy season again came round. Grass, however, was to be had in the forests of Thana, two to three hundred miles away, and so it was arranged that as soon as it was ready for cutting, at least one train per day should be loaded with it. Meanwhile, another experiment was tried. It was said "As well as bringing grass to the cattle why not take the cattle to the grass? In the forests of Thana there is plenty of pasture land; the trains are pouring in with grain and fodder, why not utilize their return journey to carry back selected animals?" It was not so easy as it may seem, but we got to work, arranged for reduced railway rates, and placed the forest pastures in charge of a vigorous Englishman, Mr. Wood, of the Civil Service, who undertook to look after the cattle on arrival, to get them registered, to provide them with water and fodder on their way from the stations, and to allot them grazing grounds. But the first real difficulty arose at our end; the people would not on any account let their cattle go. The rumour passed from mouth to mouth that it was all a device of Government to get cattle to ship to Africa, for the Boer War. "What the English really wanted was beef for their soldiers, and oxen to drag their waggons in the Transvaal. It was all very well to talk about the forests in Thana, but once the cattle were shut up in the train, they would never be seen again." I was encamped near a railway station in the district of Broach, when word was brought that a lot of animals that had been collected to send off, had been carried back by their owners during the night, and so to end the deadlock somehow a meeting was called. They came, hundreds of shrewd weather-beaten men very friendly, but very doubtful. So much interest had never been taken in their cattle before, and there must be something behind it. Finally, it was agreed that a dozen animals should be sent by way of experiment, and that two of the farmers should

go along with them and see what become of them. It reminded one of the Israelites sending the spies into the land of promise, and like the spies they too returned bringing back word that the land was good, and that the Englishmen there evinced no special desire for beef. They also brought with them not bunches of grapes but bundles of grass to prove the quality of the pasture. From that day difficulty No. 1. was at an end, and far more animals were offered than it was thought prudent to send. Another trouble will illustrate how hard it is for East and West to meet even on the lines of charity. The prevailing religion in this part of India is the Jain, the leading tenet of which is the sacredness of all animal life. While in theory, the life of a beast is as valuable as that of a human being; in practice, it has become more so. As a matter of daily conduct, it is as great a sin, or a greater, to kill a flea as to kill a man. This popular sentiment found its expression in ordinary times in the maintenance by the wealthier merchants of asylums and hospitals for ownerless and decrepit animals. Now, recognising that we could at the best only save a fraction of the people's herds, we carefully selected the most valuable—the most worth preserving. The merchants, on the other hand, doubled and trebled their subscriptions to their own fund, and chartered trains to carry away to the pastures, not the best, but the worst, actuated by much the same feeling as would lead us to rescue first from a burning house the most helpless of the inmates. The rolling stock was limited, and the railway would give us no preference because the merchants were in prosperous times their best customers, and hence we often had the mortification of seeing scores of trucks depart, loaded with refuse animals, many of whom died on the way, instead of young and strong stock, which might have come back at the end of the season to help the people to regain prosperity. However, at last about 10,000 head were got off, Government lending the money to pay the charges. But it did not turn out a success, the main reason being that the Gujerat cattle, like their owners, were soft and little used to roughing it. The rocky ground, so different from the sandy plains of their own province, worried them; the coarse, unaccustomed grass of the hills did not nourish them; and the water did not suit them. Their own herdsmen, who knew their ways and whose care might have softened their lot, also disliked the foreign country and ran away. So that in the midst of a rough plenty they died by hundreds. Not more than 40 per cent. ever came back. The conclusion was, that if similar conditions should ever recur, it would not be advisable to deport the cattle but rather, at any cost, to keep them at home under the personal care of their owner. It is only a phase of what I believe to be an elementary truth in Oriental government — that in dealing with famine, or plague, or any other trouble, that policy has the best chance of success which preserves intact the family life.

In the month of December the dry grass began to pour in from other provinces, and the question was how to distribute it. If we sold it the danger was that large quantities would get into the hands of the rich merchants, who would use it to feed the animals that were not worth keeping, whereas, we only had enough to feed a comparative few, and we wanted them to be the pick of the country. So it was decided to establish cattle camps where only young and well-bred animals were taken in and fed under our own control. The experiment was a novel one, and it is not surprising that we made mistakes. The first camp was a failure. The animals admitted were already too run down to digest the foreign grass, and most of them died. We had come to see that it was out of our power to save even a large fraction of the two millions in the province, but the breed was a fine one, admirably adapted for the deep sandy soil of that part of India, and so the able Director of Agriculture, Mr. Mollison, set himself to the more limited task of saving it from practical extinction. Those cultivators who could get any fodder at all were inclined to save their oxen as being of more present value, and to let their cows die. So he took in chiefly cows, well-bred, young and strong; he limited the number in each camp to about 300 to allow of close supervision, and he gave them a daily ration of oil cake to supplement the innutritious grass. In the end in these camps, besides oxen, several herds of cows and a number of sires were saved—about 9,000 head in all—who formed nuclei for repairing the loss of the famine. Without these it is tolerably certain that the famous breed of Gujerat cattle would have disappeared. It was not a colossal achievement, but it was worth doing. The work was extended and made permanent by the munificence of Lord Northcote, who gave Rs. 25,000 for the purpose of establishing a central farm for the study of cattle and dairy farming.

The management of the camps made us acquainted with qualities in the Indian cattle we had never suspected. The truth is the Indian cow and ox have a much better chance of developing character than those of other countries. The cow has, you are well aware, for many centuries been esteemed as the holiest of animate beings. To kill a cow is an unspeakable sin. A very popular religious print represents a departed soul at the river of death getting safely across by holding on to a cow's tail, while others, not so befriended, are torn by terrible fishes. The Brahmani bull has the freedom of his village. The cultivator's ox, too, is treated as a member of the family. He occupies as good a room in the house as his master On gala days he is painted with red, decorated with flowers, and fed with grain and spices. Now, if environment goes for anything it is not surprising if, after centuries of this human treatment, the domestic cattle show some signs of "clubbable" qualities. When the first camp was started, one of the rules drawn up by a European expert was that the animals should be sorted according to size. If big and little were enclosed together, it was thought the little ones might get the worst of it. But it was soon discovered that the bond among Indian cattle was not their size but their village. If they belonged to the same "set" they knew one another and kept the most perfect order. They obeyed the herdsman's voice and even the crack of his finger, and so far from hustling the little ones they took care of them. On one occasion, in the camp already mentioned, their good manners were sorely tried. It was the first day on which a basket of oil-cake was brought into the enclosure. They were taken off their guard, and with one consent they rushed at the unfortunate man who carried it, and knocked him over in their eagerness to get a piece. But a very short time was enough to bring them to a sense of propriety, and it was a pretty sight in after days to see them at the appearance of the basket range themselves in an orderly row, each one awaiting his or her turn. One incident I should hesitate to mention if it had not come to my knowledge on the best authority—an eye witness whom I entirely trust, though I scarcely expect others to do so. In one camp in the Panch Mahals there were several sick animals who were set apart and fed with special food which some of the others saw and coveted, and in order to get it themselves they lay down and shammed to be sick also.

As there was still a surplus of grass we began to sell it to *boná fide* cultivators at cost price, viz., Rs. 10 per 1,000 lbs., roughly about £2 per ton. By May it was recognised that the situation had entirely changed. All the useless cattle had now died and so been eliminated. None remained in the hands of private owners, except the very best which the more well-to-do had strained every nerve to save. In most cases they had now come to an end of their resources, and from every side the cry arose that they must give up the struggle unless help was given them to tide over the last two months before the expected rain.

An appeal was made to the Committee of the Mansion House Fund, and they liberally authorised us to buy up all the available stores of grass and re-sell it to genuine cultivators at an almost nominal price. More than once I stood at one of the depots, among the people flocking in with their carts, some from a distance of fifty miles, to get the precious fodder, and explained to them in their own language how their brothers and sisters in far-off London, fellow-subjects of the great Queen, had heard of their trouble, and had sent money out of their own purses to help them. If any subscribers to the Indian Famine Fund of 1900 had been present it would have done them good to see the care-worn faces light up in response. I felt that here was a bond of Empire more real and more lasting than even Bismarckian blood and iron.

I must now pass to the saving of the men and women. You will remember that they almost all lived on agriculture. Barring a few mills which exported a little cloth and yarn, the harvest of the year was the one source of wealth. I ask you to imagine the state of England if next year, not only the land were turned into a barren desert, but if every factory and mine were closed. It is not surprising that by the month of April there were over a million dependent on direct charity for their daily bread. They included at one end some smaller yeomen, and at the other end wild hill-men who fled into their huts like rabbits at the sight of a white man. Among them were men who were too proud to come to work, others who were too timid, others who were too lazy; women of good birth, who would rather die than show their faces or beg; sick people, old people, young children whose parents could not support them, or had deserted them, or had died and left them orphans—a great variety of sorts and conditions. It was clear that no one system of relief would suit them

all, and I will describe in a few words the efforts that were made under the orders of the Government of India for each particular class. The fundamental principles laid down by Government, and on which they elaborated their system were (1) that no able-bodied persons should receive food, except in return for a fair amount of work done, and (2) that no one should be allowed to die of want. Hence the first step was to open at convenient centres, earthworks, such as embankments for a new railway or excavations for storing water—the men to dig, the women and bigger children to carry. The amount of daily food necessary to keep a man, woman, and child respectively, in health was ascertained, and the money necessary to buy it at the price for the day of the local shops, was taken as the standard wage. Similarly, the amount of digging and carrying that could be done in a day was estimated and exacted for the full wage; and, on the best-managed works, measurements were made every evening and paid for on the spot. But the supervision, so as to avoid waste of public money on the one hand, and underfeeding the people on the other, involved minute and incessant care. So many cubic feet might be a fair task so long as the digging was in loose and sandy soil, but if it passed into stiffer soil without being noticed by the official in charge, and the same quantity was still exacted, the worker was overtaxed and began to run down. If wages were not paid punctually he might have to go without his food, or he got it on credit, which meant that he got less. Or if prices in the local market went up or down, and the rate of wages were not promptly raised or lowered accordingly, he got less or more than he needed. Then again, as an instance of the continuous conflict of wits between relievers and relieved, it was found that most people came to the work on empty stomachs and so a rule was made that they should be given a square meal before setting them to do any labour. Many vagabonds at once took advantage of this by appearing late in the day, getting their meal and then slipping off next morning and walking to another work to do likewise. A responsible superintendent was placed over every work, but our chief reliance was on the Famine Officer, generally an active Englishman, who was placed in charge of an area about equal to half an average county. His business was to ride about everywhere and keep his eyes open. If he found people starving at home or on the roadside, he was to find out why they did not go to the Government work. Was the fault in themselves or in the work? If the people on a work looked feeble and running down, if the numbers on a work dwindled, if the people flocked to one more than to another he was to find out the reason. If a large proportion of the workers failed to do the daily task and consequently did not earn the full wage why was it? Was the task too heavy for the average person, or did any negligence of the staff prevent their beginning in good time in the morning, or were the people only playing with the work, not being in real need of it? If he found men or women on a work so sick or weak that they ought to be in hospital, if relations and friends instead of being grouped together were harshly separated, if new-comers were not promptly taken on, if the food in the shops was bad or overcharged, he was to interfere at once and set things right. If the work was not large enough for the numbers needing relief, or if the staff was insufficient or inefficient, he had to report to superior authority. In one case it was discovered that by an official blunder the rate of wages was based on the price per lb. of husked rice instead of unhusked; in another, that worn copper coins were being issued from the Treasury for the daily wage on which the shopkeeper charged a discount. Both these mistakes made all the difference between enough to eat and not enough. On some works five to ten thousand people were employed, besides their young children and other dependents, and it will be easy to see that the task of holding the balance between their needs and the claims of the public purse was no light one. A slight oversight, a slight error of judgment might in a few days do irremediable mischief. For one grim axiom we have learned in the study of recent years is that in the administration of famine relief there is no room for atonement. If mistakes are made and the people once allowed to run down there is no getting them up again. The depressing surroundings, the exhausting nature of rigid and unaccustomed toil, the monotony and inferiority of famine diet, all prevent the recovery of tone that is once lost; and the only way of bringing a population through a famine with success is to keep up from the beginning their courage and vitality, and never to let them lose heart.

So much for those who were able to work.

But in almost every household there were many who were not able to work—young children, weakly women, elderly or invalid relations. The question was, and indeed is still, unsettled what should be done with them. The course most congenial to the people would have been to let them stay at home and to feed them there while the ablebodied went to work. It was thought wiser not to allow this, but to build huts for all near the works and to make a daily allowance to the house fathers for every member of the family unable to earn a living for himself. I doubt if we entirely realise the distress of the people at having to leave their roof-tree and their village. It was said to lead to immorality. It certainly disrupted family life. The more respectable a man was and, therefore, in a sense the more deserving, the more he shrunk from it. On the other hand, a fair and honest distribution of relief whether in food or in cash to those helpless people in their own homes scattered in thousands of villages, would have been far beyond the power of a limited staff. There would have been negligence, favouritism, and peculation, and the whole machine would have got out of hand. Not only so, but it was found by experience that if families were allowed to stay at home the fathers and elder brothers stayed also, preferring to half starve on a share of what the others got rather than go and do a hard day's work for themselves.

Far more difficult to deal with was the large floating population—immigrants from Native States and men and women who were too indolent or too timid to go to the Government works, who stayed at home until hunger drove them forth, and then wandered blindly off they knew not whither, growing weaker day by day. An extract from a demi-official letter from a district officer, describing a very common incident, will illustrate the difficulty:—

"I was riding this morning when I saw a woman with an infant, who, when she saw me, crept behind a hedge. I rode up to find her in almost the last stage of exhaustion from want of food, and went on to the nearest village for a litter and bearers. When they came the woman was nowhere to be seen, and it was not till after ten minutes' search that we found her in some bushes to which she had crawled in the hope of escaping us."

For these wandering people poorhouses were provided at the chief centres, where the starving were taken in and fed, and all such as had any strength in them were drafted off to the nearest work. Among them were of course found the most worthless of the community. So long as they were allowed to stay in the poorhouse and get their daily meal they gave no trouble, but when sent to work they at once escaped and drifted back into the streets, where they begged from door to door, gradually losing flesh until they lay emaciated and moribund. Our hold on this class was much weakened by the indiscriminate charity of the townspeople. It is a sign of piety in India to give to everyone who asks. Most persons, of course, do not attain to that high pitch of virtue, but the object of all religious men is to spread their charity over as wide a ground as possible. The sugar-cane grower when he gives a dole of molasses to every religious mendicant in order to atone for the destruction of insect life in his mills, makes no distinction between Hindu and Mohammedan. At a place of pilgrimage large numbers of beggars congregate, and a pious person instead of giving a handful of corn each to a few, passes down the line giving two or three grains to each and everyone. The object in both cases is the same, viz., to avoid the risk of offending anyone, for the curse of even one is held to be more potent than the blessings of many. I remember a man who lived near to me at one time, and who impressed me much with the crowd of poor people who assembled at his house every Sunday morning to receive alms until I learned he gave to each a coin equivalent to half a farthing. Now, it will be understood what a trouble such people were by dealing out driblets of food, just enough to keep the lazy from honest work but not enough to keep them in health. A frequent annexe to the poorhouse and often to the relief work was the orphanage. I am free to confess that Government never succeeded in this branch of relief and never will succeed. Given a stout and sturdy child who can eat his daily ration, and the official agent will keep him going, in a way, but given a wasted famine starveling, and nothing will save him but such care as cannot be bought. The devoted Christian women missionaries who sought out wretched little ones and mothered them back to life, deserved, as they gained, the gratitude of the people.

There still remained lurking in their houses people who had to be sought out and saved in spite of themselves. Some remained out of sheer timidity or obstinacy, reminding one of animals who will not move when the stable takes fire. Others were sick or crippled and had no friends to move them. Most pitiful of all were women of higher rank who had nothing

to live upon, and who were willing to die rather than incur the disgrace of showing their faces in public or taking open charity. You are aware that the family life of these classes is wrapped in secresy. If one were conversing with a native gentleman and took occasion to enquire after the health of his wife and family he would take it as an insult, for an outsider is not supposed to know of their existence. You will understand how careful the district officer had to be in selecting agents to search out these sensitive people and to save them from starvation without wounding their feelings. For the men of this class the latest Famine Codes provide that they shall be employed as clerks and overseers on the works, but this is not always possible. By way of experiment special works were set apart exclusively for them, but without much success. People, too, who though not of social rank, were unaccustomed to manual toil, suffered much. In one part there were many graziers on the works. Every family of them was, before the famine came, the owner of perhaps a hundred head of cattle—some more, some less—and earned an easy and leisurely living by making butter and breeding stock. Some of the male folk had taken the animals and gone off in the vague hope of finding a land of plenty, but no word had come from them, and the chances were that neither man nor beast would ever return. Those who remained behind, having spent all, were driven to break up their homes and come to relief works. They had never done a day's manual labour in their lives, and their blistered hands and hopeless, yet patient faces, could not but evoke pity. It was only their splendid constitutions, built up in the fresh air and on nourishing food, that saved them from dying, as so many did, from the mere shock. Artizans, chiefly weavers, were another class on whom the burden fell more heavily than on the ordinary day labourers, who chiefly sought relief, and also when engaged in the finer industries, the rough work of digging was said to unfit them for reversion to their proper occupation by blunting their sense of touch. Here again the missionaries did good service by supplying yarn to weavers at the cost of private charity, and taking back the woven cloth.

The climax of the year was reached when word came in from many points that cholera had broken out. I doubt if the fear of cholera, as a year of famine wears on into the hot months of April and May, can ever be removed, for the two predisposing causes will always, or nearly always, be present—bad water and deficient vitality in the people. It is a matter of common observation that the victims in an epidemic of this disease are mostly persons whose nervous powers have been already enfeebled either by ill-health, or by fatigue, or by panic. Dr. David Wyllie, once a well-known member of the Indian Medical Service, used to be fond of telling how in a cholera year he paraded all the prisoners in the jail when they came in tired from their morning's work and dealt out to them an allowance of grog, and how not a man got ill except one who was found on inquiry to have been absent from the parade on the day of his seizure. Every layman even, who has seen much of cholera, knows that those who keep up their spirits are most likely to recover. Hence what could be easier prey than a crowd of Indians gathered away from their homes at the end of a year of grinding famine? Everything combines to depress a people whose inclination at the most cheerful time is to succumb to any attack. The famine officer has not to fear "bread riots" but the very patience which makes the people easier to handle at first, recoils against him when a wave of cholera passes and the problem is to brace them up. Often the subordinates from the native medical officers to the menial servants stick manfully to their posts but sometimes they do not. More than once in 1900 the higher officers were left almost alone to deal with camps of dead and dying.

As the month of June approached the winding-up began. It would require another hour to tell how the people were got back to their villages and helped until the new crops were ready; how Mr. Mollison devised a light plough for draught by men; how cattle were supplied from Central India on behalf of Government, but still more by private enterprise; how enormous loans were made from the Treasury to enable the farmers to buy not only cattle but seed and labour; how the Mansion House and other private funds came in to set up again many a broken man. Unhappily, too, for Gujerat, the story would not be conclusive, for, owing to insufficient rain, followed by rats and locusts, the season of 1900 was little better than that of 1899, with the important exception that the early rain was sufficient to produce fodder. I, therefore, pass on to make, in closing, two or three general remarks.

This paper may perhaps suggest to some a more vivid conception of what famine

still means, especially in a province like Gujerat, where the people have not, like those of the Deccan, developed famine-resisting qualities. The steady routine of the relief work bears hard on the man who usually worked when he pleased and how he pleased. The ration of imported food, the same from day to day, is a poor substitute for fresh vegetables and milk or whey and home-made bread to which he was accustomed. I do not know if there is any physiological explanation of it, but it is an undoubted fact that natives of India are more sensitive to changes in diet than Europeans. If the question is asked in the villages what the people died of in the famine year, the most usual reply is not "want of food," but "they died of eating the train-borne rice." An Indian friend of mine speaking of this said, "Yes, it is quite true; I can afford good food, and yet whenever I go to see my brother in Bombay, who eats rice from Burma, I get unwell." Another said, "A large number just above the lowest class did not die of hunger but of nervous collapse." A cultivator's savings for the most part at such a time, so far from being a help, were a drag upon him. If he had any money to spare in good times he never put it in the bank. He might lend some to his neighbour, who in time of famine only made of it a further claim to be kept going. First of all, he would lay it out in the purchase of oxen or a cow. The leading men in good times would make a brave show of cattle—several pairs of oxen, a few cows and calves, and a pony to ride; bnt in time of such famine as that of 1899 they only meant so many more mouths to fill.

The second note is that famine relief has grown into a special study. During the last thirty years or so India has had many visitations, each of which has been utilised by Government to gain and garner experience, and each of which has left them better equipped for fighting the next. Their famine codes lay down beforehand with consummate generalship the plan of campaign—affixing the responsibility for watching in ordinary times the condition of the people and suggesting means of improvement, for detecting and reporting the danger signals as soon as they appear; providing for estimates beforehand of the number and classes of persons who may require relief in case of famine, and for maintaining programmes of suitable works with plans and supplies of tools; authorising and ordering prompt increase in the district staff, including doctors and police; the suspension or remission of Government revenue; the adaptation of methods to the various classes according to their physical powers and position in life; the early organisation of gratuitous relief of those who cannot work; the utilisation of voluntary private help; and generally with minute foresight setting aside routine and red tape without relaxing real control, and ensuring co-operation among all concerned. How new this branch of economic science is may be gathered from the fact that in the ninth and tenth editions of the *Encyclopædia Britannica* thirty-nine columns are devoted to the confused and unscientific system of English poor-law, while not a word of mention is given to the carefully devised system of Indian famine relief.

In Gujerat the one alleviation of famines under native rule was the storage of grain by the small landlord whose practice it was to fill a pit with the surplus of every good year. This is the oldest method of fighting famine in the world, and it is superficially so natural that many still advocate a reversion to it. To begin with, it is impossible to carry it out on so huge a scale as is necessary to make it really effective. Probably nowhere in the continent was the custom so established as in Western Gujerat and Kattiawar, where in some villages there were as many as ten or a dozen pits at a time representing as many years. Yet in that very area there are early records of parents eating their own children. There is, too, the risk of deterioration in the grain; there is the certainty of loss of interest on the value. In the days when the science of locomotion was but little advanced there was much to be said for it, but in these days the ideal of Government is, and should be, not to bury the surplus in the earth or in a warehouse, but to invest it in irrigation, in railways, in agricultural improvements. So far as it is necessary and prudent to retain the harvest of one year against the possible deficit of the next, experience has shown that it is safe to leave the business in the hands of the private dealer who would only be discouraged and embarrassed by the collaboration of Government. The corner stone of modern relief is easiness of transport. It has been pointed out that the invention of printing, much lauded though it is, would have been of little value to the world if it had not been accompanied by the invention of paper; and just so the modern famine policy would have been futile without the introduction of the railway. At the first

signal of a failing harvest the telegraph is set to work, and in a few days if need be, train-loads of grain pour in, the rising prices fall, and "there is corn in Egypt."

Meteorological enquiry has not yet laid bare the causes which deflect the rain current and produce famine. Some day it will. Meanwhile a theory which by means of iteration and re-iteration has gained some measure of assent, is that which assigns the recurrence of famine and the disaster it entails, to the administration of the British Government. Annually our friends in Congress are promised in a peroration from the Presidential chair that when all power passes into Indian hands famine shall be no more. I can only at this moment refer briefly to the report made by Colonel Etheridge in 1868. If his enquiry into past famines had been deferred until only a few years later, the whole truth would not have come to light, for the native rulers often thought so little of famine that they neglected to record it. In 1868 there were still old men alive who remembered what they had seen or heard of olden days. Authentic evidence was gathered of 16 distinct famines in one or other part of the Bombay Presidency between 1770 and 1825, while between 1825 and 1868 there had been nothing to justify the name except in the native State of Cutch, on the borders of a rainless desert. One of the witnesses said, "It makes one tremble even at this day to think of what happened"—grain selling at a rupee per pound, girls selling at eight annas apiece, villages depopulated to this day, and fathers eating their own children Charitable people opened cheap grain shops, but the weak were not allowed to profit by them, being elbowed out and trampled down by the stronger. One of the worst of these famines occurred in 1847 according to the Indian calendar, 1791 according to ours—and to this day a popular oath in the districts affected is "May all the sins of '47 rest on my head if I speak not the truth." The bonds of government and of society were broken, and in their hunger and despair men "feared not God, neither regarded man."

It is true that famine does connote a difference between past and present. It has ever existed, but it once meant abandonment of the people, desolation, cannibalism. It now means much distress, much mortality, it is true, but also persistent and thoughtful effort to diminish it, approaching by dint of severe experience ever nearer to the ideal when everything shall be foreseen and forestalled. I am not of those who think the work of England in India is done or nearly done. To affect that it is and to shirk our burden before the time will not be magnanimity but indolence and cowardice. If Englishmen and Indians will to themselves prove true and to one another, the golden age is not behind us but in front. Part of it will be this new gospel of famine relief, the object of which does not begin and end in keeping down the Bills of Mortality. It appeals to, and desires to enkindle, a sense of the brotherhood of man and the worth of human life—a sense which is at present almost non-existent in the East, being stifled or perverted by Caste. It seeks to organise pity, to codify self-help against the forces of Nature. It brings men side by side in a life and death struggle, and strips them so far as is possible of the adventitious differences of race and education. It welds them together in a fire of common trouble and a common task. With the memories of those sad years are blended the faces of many faithful men who spent themselves without stint, but especially of five who, it is safe to say, were the first in the history of the province to give their lives to save the outcasts — the outcasts and aborigines—who still to Brahminical feeling are something less than dogs. There was Maneklal Narbheram, who went a healthy vigorous man to the Wagra tabula of the district of Broach, and for six months never spared himself night or day, and then returned, a wreck, to die a year afterwards. A brave and steadfast man who knew what was before him and did it. There was Mulligan, Presbyterian missionary, who when the head of the district was in sore need of strong men volunteered to help and was put in charge of a thousand persons on a relief work, on whom cholera had already taken hold. There was Mawhinney, also Presbyterian missionary, who undertook a similar trust in the adjoining native State of Sunth. Each of them took up his abode among the people in a hut like their own; he restored order and cleanliness; he instilled some of his own courage; and then each within a month of the other was stricken with the disease from which he had saved others, and died the death of a Christian.

There was Thompson of the Church Missionary Society, who had sole charge of a large district of Bhils in the Native States of Northern Gujerat. He was worn out with his heavy burden, and he was seized with cholera when 35 miles away from the nearest European, sur-

rounded only by his faithful Bhils. They tried to carry him into head-quarters, but on the way he told them to stop under a tree and there he died. As a comrade wrote afterwards, "he loved his Bhils and they loved him; he has been true to them in his death and they to him."

Lastly, there was Jenkins, a Civil Engineer in the Public Works Department, who was in charge of works in the Panch Mahals. He was lying in his house with high fever upon him, when word was brought that a certain work would soon be stopped and the people dispersed if further alignment were not made. He got up and travelled to the place, and did what was needed, and then returned, with his illness, of course, much aggravated. In two days he too was dead.

I make no apology for mentioning these names, for the blood of such men is the seed —and the sap—of Empire.

DISCUSSION.

The CHAIRMAN said he thought it would be the opinion of all that they had listened to a paper of a somewhat unusual character even in the annals of the Society. They had not been given a learned treatise, though no one would have been better qualified to give it than the author, had he chosen, upon the origin and incidence of Indian famine; neither had they had a paper crammed with figures, statistics, and tabulated accounts, such as were apt to find their way into Blue-books and into Moral and Material Progress Reports. Neither, again, had they had anything in the nature of a political pamphlet; but an officer had stood up before them distinguished, as he (Lord Curzon) had said in his introductory remarks, for his sympathy with the peoples of India, a sympathy never better shown than in the great famine which he had described, and which he had assisted to administer with surpassing devotion and zeal. He had stripped off the mask from the mysterious figure of India, mysterious at all times, but never so inscrutable as in the hour of suffering, and had shown exactly and actually what famine meant in its effect upon the people, their families, their households, their cattle, and their lives, and what were its incidents and lessons. Anybody who knew the author or India at all well would be able to certify to the truth of the picture he had drawn. Perhaps he himself might be allowed to give his testimony in its favour, on account of the experience he had necessarily acquired in administering the famine to which the author had referred. Sir Frederic had been one of his most prominent officers in that great undertaking; and as he listened to the paper he could not help recalling many incidents in the course of that terrible visitation, some of them witnessed in the company of the author. The paper, so full of eloquence and of pathos as it was, brought back to him the scene of the poor-houses, those places in which they had tried to collect the human drift-wood on the great ocean of destitution; the kitchens, where twice a day pottage was handed out to the groups of people, men in one part, mothers in another, and children in a third, all seated upon the ground; the hospitals, where the fever-stricken and emaciated patient were lying, with that gentle resignation they knew so well, side by side upon their humble beds; and the cattle-camps, where animal life was treated with as much care as though it was human. And perhaps, most of all, the paper brought back to him, as the photographs recalled, the spectacle of those great relief works, upon which the Government of India employed tens of thousands at a time. Sometimes it might be a road, where the gangs of workers were arranged, some according to their village, some according to their sex, and some according to their strength and size, engaged in breaking the stones that were to constitute the metalling of the road; sometimes it would be the embankment for some railway of the future; sometimes it would be a great tank, or reservoir, or lake construction, with a view to irrigation service in the time to come. There would be seen, as he had seen scores of times, thousands of men, women, and children, creeping with their loads up the great dyke, shooting the soil to the ground, hammering it down, and thus earning the small pittance which kept their bodies and souls together, and which was the sole means by which the Government of India saved them from the death that would otherwise have overtaken them, either in the villages or along the roads. All those experiences were sad enough, and it was unnecessary further to dwell upon them. But there were two popular misapprehensions connected with famine in India he would like to refer to. A good many people might imagine that the majority of the people engaged on the relief works were in a very emaciated condition, the sort of living skeletons that were sometimes seen in photographs appearing in the English illustrated newspapers at times of famine in India. He had looked with some interest that afternoon to see what would be the character and physique of the people who were depicted on the slides shown by the author, and he was interested to observe how entirely they bore out his own recollection, which was that, on the whole, the people seen on relief works were in an astonishingly good condition. And they were so because they had been taken hold of by the Government in time; and it was the Government's object, by the work and the pay it gave them, to keep them in good condition, as the only means of saving them from death. It was not the people on the relief works but the skulkers who could not be tempted out of their huts and hovels in the villages, the poor aimless wretches who drifted in hundreds and thousands from the Native States across the border into British territory and then perhaps back

again, and the thousands of people who were either too timid to solicit or too proud to accept assistance, that were the sufferers. They were the people whom Government was always trying to draw into its fold, and who, if it failed to do so, collapsed and died. The second popular error was the belief that the mortality that occurred in famine was in the main due to starvation, *i.e.*, to lack of food. Many as were the harsh and unjust charges that were brought against the British Government in India, there was none more cruel or ungenerous than the statement that millions of persons perished of starvation in an Indian famine. In the first place it should be remembered that what was called famine, was commonly only scarcity, in varying degrees of intensity. It was not the complete absence of food supplies or the death of persons resulting therefrom that was the chief difficulty, so much as it was the administrative problem of dealing with large masses of people, whose vitality was impaired. Secondly it was to fever, cholera, diarrhœa, and dysentery, all the diseases in fact that preceded or followed upon famine, that the mortality was principally due. If there was one thing more true than another in the paper, it was the remark that the Indian had not a reserve of physical or, he might add, moral resistance. His vitality was at all times at rather a low ebb, and when a great emergency came, particularly when that emergency was attended by illness and disease, he was apt to gutter out and die. In every famine there was, of course, considerable mortality, but in each visitation it grew less, because of the greater experience the Government had behind them, the more highly organised staff collected for the purpose, the programmes laid down for officers to carry out, and, perhaps, also because of the greater intelligence and understanding of the people themselves. It would be easy to go back to the native period of rule, before England took over the government of the country, and to show from the writings of native historians how different were the conditions in those days. It had been his duty to study many of those documents, and what the author of the paper had said was undoubtedly true—famine in those days meant a loss of life so terrible that often it amounted to the complete depopulation for an entire generation of districts as large as many States. It was characterised by complete and callous indifference on the part of the Governments of those times, by appalling sufferings on the part of the people, and, by horrible and revolting scenes. Those days had gone by never to return, and the change undoubtedly synchronised with the period at which the Government of India was effectually taken over by the British administration. If they looked at the long time that had elapsed since then, it would be found, he thought, that it might be roughly divided into two epochs. Firstly, there was a period of about 100 years, dating, say, from 1770, during which no scientific effort was made by the Government of India to cope with famine, not because it lacked the sympathy, but because it had not the knowledge and the machinery, and because at that time expenditure upon famine was regarded as the legitimate field of private charity rather than as imposing any call upon the funds of the State. That condition of affairs went on for a century and then some 40 years ago, dating with the Orissa famine of 1866, the revulsion came. From that time forward, the State commenced seriously to admit its obligations in respect of famine. With each successive famine the scope of that admission was increased, until it fell to his lot, in the famine of 1899-1900, to make the statement on behalf of Government that no single rupee would be spared by which they could hope to mitigate dire suffering or to save human life. Another cause and evidence of their advance was the fact that after each famine as it now took place, a commission of experts was appointed, who visited the localities affected, took evidence from all classes, official and unofficial, analysed the incidence and symptoms of famine, and then recorded their experience and judgment in a series of recommendations which at once fell under the attention of Government, and were probably made the basis of some pronouncement for future action. Hence it was true to say, as the author had said, that there had gradually been evolved in India a science of famine relief, a science sufficiently elastic to be capable of adjustment to the circumstances or the requirements of different times and localities, but at the same time sufficiently precise to be embodied in great codes of famine procedure drawn up for each province in India, which while suited to the circumstances of the district, were yet based upon broad principles of general adaptation laid down by the Government of India and applicable to the whole country. He had spoken of the fulness of the Government's acceptance of the obligation of relief; and he could not give a better idea of what that involved and the scale upon which it had been done than by pointing out that at one period, in July, 1900, there was a spectacle in India such as had never before been seen in any civilised country and which he hoped would never again be seen, namely, no fewer than six million persons in receipt of relief from the Government. Again, the Government stinted no money, as was shown by the fact that in that famine the total expenditure amounted to nearly ten millions sterling. As soon as the first indications of famine threatened, the Administration settled down to its work, prepared plans, and, when the visitation fell, carried through its operations from start to finish with just as much prevision, anxiety, and study, as a great commander might do who was laying down the lines of some momentous military campaign. That they would ever be able altogether to prevent famines in India, the climate and the population being what they were, was, he thought, at any rate within any time they could measure, extremely unlikely; that they would seriously reduce the frequency of famines he hoped

was probable; that they were markedly mitigating, that they had already markedly mitigated, the severity of their incidence might be regarded as absolutely certain. There were certain observations in the concluding part of the paper that he wished to associate himself with before sitting down. If administration in high places brought one, as he thought it sometimes did, in contact with the seamy side of human nature, a great ordeal like an Indian famine also showed one the reverse side of the picture. It showed one the nobility of which human nature was capable; its capacity for self-sacrifice, and its sense and power of duty. As he looked back on the experience of that time, he did not know whether more to admire the patient and uncomplaining resignation of the native peoples, the sufferers themselves, or the heroism of the officers, both English and native, civil and military, to whom the charge of all those suffering thousands was committed; or the devotion of the missionaries, English, American, Canadian, European, of every nationality, women as well as men. They literally stood for months between the living and the dead, and they set a noble example of the creed of their Master. Many of those persons rested in forgotten graves, but he hoped it was not presumptuous to cherish the belief that their names were written in the Book of Life. Let those who wanted to see what the British Government was capable of doing in India go there, sad as the experience might be, not in prosperous times, but when the country was in the throes of a great famine, and they would see what no Government in the world had ever attempted to undertake in the past, what no Government in the world, except our own, was capable of undertaking now, and what he firmly believed that no Government, European or Indian, by which we could conceivably be supplanted or succeeded, would dream of undertaking in the future.

Mr. Henry Staveley Lawrence, I C.S. (Director of Agriculture, Bombay), remarked that he was not privileged to take an active part in the noble campaign against famine of which the author had given so powerful and touching an account, but during the period in question he was employed at the head-quarters of the Bombay Government, and was in a position to observe very closely the progress of events. It was not necessary for him to add any details to the vivid pictures which had been drawn by the Chairman and the author, but he would base his remarks on two points only. In regard to the loss of cattle in the province of Gujerat, he might add the gratifying news that that province had, to a very great extent, recovered its losses. Last March, at a cattle show in Ahmedabad, the villagers assured him that, though good bulls were scarce for breeding, the six years which had passed had enabled them to restock their herds, and the cattle farm which Lord Northcote and the author had established in 1899 was being utilised for the gradual supply of that want. That farm was now in a flourishing condition, having been taken over by the Government and established as a permanent institution, and the want of good bulls was being slowly supplied from that institution. The author had referred to the duty of Government to invest its surplus revenues in irrigation, railways and agricultural improvements, and he should like to offer a few remarks on the first and third of those matters. Irrigation and railways were already fully recognised in the famine programme, but there was still some doubt about the matter of agricultural improvements, especially in connection with irrigation. It was known that a large extension of irrigational canals was taking place in India. In 1901 Lord Curzon appointed a Commission, whose proposals when carried out would increase by one-third the area now irrigated by canals, from 21,000,000 acres to 28,000,000. Those projects would be spread over some twenty years, and were estimated to cost £30 000,000 sterling. Of that programme the share of the Bombay Presidency proper amounted to 1,000,000 acres, and an expenditure of £4,000,000 sterling. It was difficult to appreciate the significance of those figures, but their importance to the Deccan, which was notoriously of all tracts in India the most liable to famine, would be clearer when he added that the area therein irrigated would be increased from 100,000 acres to 1,000,000 acres, ten-fold. But the point which he wished to lay stress upon was, that the task was not completed when the engineers had built the great lake reservoirs in the Western Hills, and conducted the canals to the arid plains of the East. While millions were being spent on those works, there was a danger of that expenditure failing of its full fruition for the want of a few thousands more There was a school of thought which, contended that Western science could teach little or nothing to the Indian agriculturist. It was true that the native cultivator was wonderfully skilful in struggling against the forces of nature, and in wresting a crop from the reluctant soil in spite of droughts and floods which threatened to overwhelm him with disaster. Nevertheless, in his opinion those gentlemen were mistaken; their ideas were based on the agricultural failures of 30 and 40 years ago, and they took no account of the modern development of scientific agriculture throughout the world. But in any case the question of irrigational agriculture was wholly different. The traditional lore of the Indian agriculturist was of no service to him when water was poured upon his fields in abundance such as he never dreamed of before, and he naturally made most serious mistakes in its application. That was the experience not only of India but in similar circumstances of Egypt, where Lord Cromer, with characteristic promptitude, had taken steps to instruct the fellaheen in proper methods of irrigation. Everywhere the cultivator was tempted to flood his fields excessively, in ignorance of the misfortunes which he was preparing for himself. Where the drainage was deficient his land became waterlogged, where the soil was impregnated with

alkali noxious salts would rise to the surface, and in all cases his plants ran to leaf and wood, and the fibre of his cotton or the grain of his cereals immediately deteriorated. Further, the man whose experience was limited to dry-crop fields of pulse and millet had no knowledge of the cultivation of the more valuable crops of long-staple cotton, sugarcane, and spices which were now for the first time within his reach. The Irrigation Commission recommended that agricultural experiment and demonstration should work hand in hand with the extension of irrigation; the expenditure required was comparatively trifling, and it was to be hoped that the spirit of retrenchment at present prevailing in affairs of State might not prescribe an unwise economy in that branch of the administration. As Director of Agriculture in the Bombay Presidency for the last five years, he had been able to see the difficulties of the people in dealing with circumstances of which they had had no previous experience, and he was convinced that the solution of the complex problems of irrigational agriculture required the assistance of the Department of Agriculture. That department was practically created by Lord Curzon shortly before his departure from India; and, if it continued to receive encouragement and support, it should secure the success of the irrigational policy, and be a powerful factor in safeguarding large tracts of country from the horrors of famine in the future.

The Rev. ARTHUR OUTRAM (late of C.M.S., Rajputana) said the author began his paper by saying that he was speaking as one who had come through the thick of the fight and who was an official. He (the speaker) presumed he had been asked to speak as one who also had gone through the thick of the fight, but was not an official. The author, in his valuable and interesting paper, had dealt largely with famine in districts in the plains, within reach of railways and in British territory; but to see the practical side of famine in India taken as a whole one had to look also at lessons learnt in those other districts, *i.e.*, in hilly tracts far from a railhead and (a subject which had to be delicately handled) in Native States. After the famines in these last-named districts, three practical lessons, among many others, seemed to suggest themselves, namely—(1) How to obtain a maximum of efficiency with a minimum of cost of administration. Could they not, with advantage, utilise to a far greater extent than was done, the ready-made relieving officers who existed in so many hilly tracts, where each village was on the old Scottish clan system, with headmen having unofficial perhaps, but nevertheless very real, authority? In those mountainous areas, five to ten days from the railhead, owing to the insecurity of the country at such a time and through other causes, *bunnias* could hardly be got to trade, and, therefore, all relief had to be paid in grain. In the 1899-1900 famine before starting a relief centre in the district in which he worked, the villagers were called together and, through their headmen, pledged that they would be responsible with an armed guard for all safety of grain, under certain penalties as to withholding seed grain and cattle, the able-bodied from the guaranteeing villages having certain privileges in grinding and cooking. Efficient checks were found easier to impose than at first sight might be imagined. The advantage of that system was that, beyond the actual cost of grain, no money went outside the famine district in the shape of overseers' salaries (remitted to their homes in non-famine areas), the villagers did not lose their self-respect, and the total cost of administration over the whole of his district amounted to only a fraction over 1 per cent. Then (2) more latitude in spending money. In those districts remote from the railways and when everything depended on animal transport, 20,000 rupees spent at once on grain, buying up forage and using the local animals to bring in that grain for storing while the wells still had water, was of far greater value than a lakh of rupees spent three or four months later when outside transport had to be pushed in. (3) As to the size of relief camps. From the author's paper one gathered that in the plains and railway areas large camps had advantages. In hilly and non-railway districts the selection of camps was circumscribed by the well supplies, which were in the valleys. One learned by mistakes, and perhaps those were most apparent to those who continued to live on in the districts after famine had ceased. At first sight large camps appeared to be better, cheaper, and easier to arrange for, but the after effects in hilly tracts might be far from pleasant. Apart from the insanitary condition of the ground inseparable from a famine camp, with its attendant epidemics, a large camp required such quantities of wood for cooking the food, making fires for warmth, running up temporary shelters for the destitute, and burning infected corpses during epidemics, that the originally fertile valley was afterwards only partially inhabitable; and, through the wholesale demolition of trees, the soil on the hillsides being washed away, hot and barren rock remained. Smaller camps, besides being more sanitary, not only seemed more adapted for districts dependent upon their own wood supplies, but, a greater number of camps being available, were more accessible to remote villages, and shy villagers would come more readily because nearer home. The cost of a greater number of smaller camps was certainly a little more than of larger ones, but if the policy of utilising the local headmen were more adopted, as he had suggested, the money would still all be spent within the famine area as famine relief.

Sir JAMES BOURDILLON, K.C.S.I. (late Lieut.-Governor of Bengal), said that as it had been his fortune, whether good or evil he could hardly say, to have been a great deal associated with famine work during his service in India, he would venture to make one or two remarks. Sir F. Lely had said a good deal about the welding power of adversity and suffer-

ing, and the Chairman had corroborated and expanded that remark by pointing out the way that scarcity and famine had developed the qualities, both of the relievers and the relieved. The author had mentioned the names of only a few of the heroes of his own presidency, and it would be impossible to give a complete and worthy list of all those who deserved the praises which had been uttered by Lord Curzon and Sir F. Lely. He himself could recall many with whom he had been brought in contact. They were men of all classes. There were missionaries and forest officers, especially the latter, and their utility in dealing with shy hill tribes, an art which could not be acquired by men of any other department, was beyond praise. He could recall doctors who had distinguished themselves by great devotion, and also men of the Public Works Department, civilians, police officers, and officers of the army, who, when others had fled, managed all departments of their charges by themselves. He could most cordially and thoroughly endorse what had been said about the famine bringing out the characters of those engaged. He would like to mention one instance which came under his own experience when he was Commissioner of Patna during the famine of 1896-7. He had at that time under his orders about 60 or 70 non-commissioned officers of British regiments. He confessed that when the proposal was made to him that he should put these men in charge of relief works he regarded the experiment with considerable suspicion. The British soldier was an unintelligible and a fearsome person to most natives in India, and, as a rule, had very little knowledge or very little sympathy with the natives: he knew little of their language, and still less of their customs and habits. However, the circumstances were such that he (Sir J. Bourdillon) was obliged to accept their aid; and although his apprehensions were grave and deep at first, he was glad to say that, by the end of the famine, he was able to send those men back to their regiments with the report that in not one single case had they failed to give entire satisfaction. They had adapted themselves in the most remarkable way to the surroundings in which they found themselves; they had proved themselves to be humane, patient, sympathetic, and in a very short time they won the complete confidence of the people among whom they worked. Neither of the speakers had said much upon one incidental point, namely, the effect on the people themselves, though they had spoken of the effect on those who relieved them. It had been said, by some who knew very little of the people of India, that they were ungrateful. That was emphatically not the case, and he was sure that everybody who had served in India would bear him out in that remark. It was one of his pleasantest recollections when touring round his division as Divisional Commissioner, when the famine was over and things were resuming their normal course, to remember the deep and wide-spread spirit of gratitude to the *Sirkar* which pervaded all classes and races in that Division. He would like to say a word with regard to the author himself. He (the speaker) was one of the Famine Commission of 1901, which, under the orders of His Excellency Lord Curzon, visited those parts of India which had suffered most in the famine of 1899-1900. The author's difficulties, it was an open secret, were enhanced by a circumstance from which other administrators of famines were generally free. Sir F. Lely for a long time was as a voice crying in the wilderness. At that time there happened to be no one at the headquarters of the Bombay Government who was intimately acquainted with the state of affairs in Gujerat. On the other hand, the author knew everything that could be known about Gujerat; he had served there many years, and he was well known for his devotion to the province and its people. He early recognised the gravity of the situation, and early proclaimed the necessity for instant, full and complete relief; but it was long before he could persuade the Government of Bombay to attend to his cries; therefore, whatever mistakes were made, were made not by him but in spite of his advice. The Government of India recognised that fact, and he was betraying no official secret when he said that it was the pressure brought to bear upon the Government of Bombay by the Supreme Government in conjunction with the perseverance of Sir F. Lely, that finally brought about that great measure of administrative relief which was given in that Presidency. In conclusion, he desired to refer to the fact that not a word had been said about Lady Lely. He was in Ahmedabad with the Famine Commission the year after the famine was over, and he there learned how much the author owed to the support and the encouragement of his wife. Lady Lely threw herself into the work of relief with as much enthusiasm as her husband, and he remembered hearing in particular how her devotion to the orphanages and to the cattle camps was an example to the wives of all the officials throughout the province. As an old famine officer he wished to say how true and graphic had been the word pictures, as well as the sun pictures, which the author had laid before his hearers.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his paper, remarked that what Sir James Bourdillon had just said recalled one incident to his mind. Sir James had referred to the difficulties that the author encountered in the early part of the famine of 1900 in obtaining the support of the local Government. That brought to his recollection one of the pleasantest incidents of his famine recollections, namely, a sweltering summer's afternoon when he, as Viceroy, was acting as arbitrator between the Bombay Government and the author. They sat for hours round a table discussing all the knotty problems, and it was his duty, after listening to both interests and acting with as much impartiality as he could command, to give his verdict, which he did in favour of the author. Those were

his sentiments then, and they were his sentiments at the present time.

The vote of thanks was carried unanimously, and

Sir FREDERICK LELY acknowledged the compliment.

Sir STEUART COLVIN BAYLEY, in the name of the Council and the whole audience, expressed their great gratitude to Lord Curzon for his goodness in taking the chair. It was not the first or the second time he had so honoured the Society; but they were especially grateful that, at a time when Lord Curzon was not taking part in public affairs, and was in a retirement which they all regarded with sympathetic feelings, he should have been present to show his devotion to the work of famine relief in India, and his regard and sympathetic recollections of the officers who served under him.

The meeting then terminated.

Dr. SEID ABDUL MAJID writes, as an Indian, to express his heartfelt thanks to Sir F. Lely for the noble work accomplished by him in alleviating the misery of the famine-stricken people of Gujerat, and his gratitude for the sympathetic speeches delivered by Lord Curzon and others. Dr. Majid suggests further that irrigation should be extended "to those parts of India which have more frequently been a prey to famine, and thus render the people independent of the monsoons." He also urges that modern implements of agriculture should be introduced as largely as possible. Lord Curzon, says Dr. Majid, never did a greater thing than the founding of the Agricultural College at Poosa (Behar). The writer adds:—"With respect to Sir F. Lely's difficulty in relieving those Indians who were too shy or too proud to accept relief, I am of opinion that if the task of distributing funds were entrusted to small committees composed of responsible landowners in districts, towns, and villages, this obstacle would be overcome."

Sir WILLIAM WEDDERBURN, Bart., writes:—In Sir F. Lely's paper yesterday, on the practical side of Indian famines, I was surprised that no reference was made to the great central fact, that the famines of 1897 to 1900 were not famines of food, but of poverty. To quote the words of the Famine Commissioners, "there was never in these years a dearth of food in any famine stricken tract." The cause of famine mortality was, therefore, not the absence of food, but the destitution of the masses, who had neither the coin nor the credit sufficient to buy in the bazaars the daily pennyworth of grain sufficient to keep them from death by hunger. This being the cause of famine mortality, the other practical question is, how may this cause be removed? Famine relief is all very well, but at best it is only mitigation of the calamity; and if prevention is better than cure, much better is it than mitigation. How then may famine mortality practically be prevented? The answer is a simple one, by providing that the villagers should have such a reserve of food, or money, or credit, as will enable them to tide over the failure of one harvest. This may not sound a heroic remedy, but it is a practical one; and in order to carry it out, we need that economic village enquiry, after the method of Messrs. Booth and Rowntree, which was asked for by the Indian Famine Union. The village community is the unit of India, and when we have ascertained how to make one village moderately prosperous, we get the clue by which we may make safe from death by hunger the half million villages which contain the rural masses of India.

Mr. A. ROGERS, who was prevented from taking part in the discussion owing to want of time, desired to call attention to a measure which he hopes may tend to the prevention of famine among a large section of the community, especially the Bhils and wild tribes in the Bombay Presidency and Western India. He writes:—

"It has been amply proved that the late famines with which India has been afflicted did not arise from the actual absence of food, for grain was abundant, having been carried by the railways which happily now perform that necessary task, conveying it from parts of the country where crops have been raised to others where the monsoon has failed, but from the absence of employment through which the population could earn wages with which to buy the food that was to be had in almost every village throughout the country.

"Whilst the famine of 1899-1900 was at its height I happened to be, in a private capacity, in the southern part of the Panch Mahals, where the crops had entirely failed through want of rain. I consequently saw it at its worst at Jambághora, the official residence of a Mahalkurry, where a line of road was under construction to provide labour for those who were in want. By some mistake, while provision had thus been made for the able-bodied among the people, a poor-house, at which the feeble, the women and the children would be fed, had not been established, and hundreds were literally starving. This mistake was rectified in a short time when I represented the state of matters to Lord Sandhurst, the Governor of Bombay. All this pointed to the necessity for means of employment for the people by which they could earn wages wherewith to buy food, which the local trader had collected in abundance, but which the people could not buy.

"I have now to point out that there is a species of employment congenial to the Bhils and other wild tribes of that neighbourhood and many jungly parts of the Presidency, which has been entirely neglected. I discovered that the *Antheræa mylitta*, the worm

that produces Tassar silk, for which there is an unlimited demand in England, are indigenous to the country, the cultivation of which would have provided ample employment for the people and prevented the arrival of famine at all. I propose that the Government of Bombay should nominate a Commission, to consist of the Revenue Commissioners, Collectors, Trust Officers, and others, whose first duty should be to collect as large a quantity as possible of the cocoons, of which I have specimens, when procurable, of such as had not been eaten through by the chrysalis which had not turned into a moth, for transmission to England for examination at Bradford and other places where Tassar silk is utilised. This should be followed by the encouragement of the culture of the worm itself by Bhils and other wild tribes, and the establishment of village reeling factories in various localities by measures which could not be specified here in detail. Such measures would start a new industry, such as all interested in the subject are agreed in considering necessary for the prevention of famine, and not meeting it after it has arrived.

"Why such an industry has not long ago been established by the Bombay Government I cannot understand, and I hope no further delay may be allowed to take place in doing so.

"P.S.—There are silk factories in several places in Bombay, where experts in reeling could be procured to instruct the Bhils."

TWELFTH ORDINARY MEETING.

Wednesday, February 27th, 1907; Sir JOHN CAMERON LAMB, C.B., C.M.G., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Charlesworth, Charles Dixon, 72, Egerton-road, Withington, Manchester.

Euba, Rev. W. B., Wesleyan High School, Marina, Lagos, West Africa.

Firminger, Rev. Walter K., B.D., M.A., Kidderpore Vicarage, Calcutta, India.

Robertson, Vincent Leopold, Rolfontein, P O. Amersfoort, Transvaal, South Africa.

Tebb, William Scott, M.D., Sandfield, Putney Heath-lane, S.W.

Wallace, Captain William Thomas Ewart, Entebbe, Uganda Protectorate, British East Africa.

The following candidates were balloted for and duly elected members of the Society:—

Foster, Edward, Irwin, Montego Bay P.O., Jamaica, British West Indies.

Gröne, H. Dawson, Inspectorate-General of Customs, Peking, China.

O'Brien, Lieut.-Colonel J., 4, Atherstone-terrace, Gloucester-road, S.W.

Scott, John Gray, Tramways Office, Hong Kong, China.

Sen, Baikunt Nath, Saidabad, Khagra P.O., Murshedabad District, India.

Treble, Mrs. Lillian Massey, Toronto, Canada.

The CHAIRMAN, in introducing the lecturer, said that Mr. Morton had for long been the Examiner in Typewriting to the Society, and the Council highly appreciated the work he had done in that capacity. He was sure Mr. Morton would present a useful and interesting paper.

The paper read was—

MODERN TYPEWRITERS AND ACCESSORIES.

By ARTHUR E. MORTON.

It is universally conceded that writing machines, by eliminating the delicate muscular labour that so greatly reduces the speed of pen work, have effected one of the most notable of the quiet revolutions in the literary and commercial world of recent times. They have crowded out opposition and lived down all reproaches, and clearly proved their claim to be considered time and labour-saving instruments.

The title of my address "Modern Typewriters and Accessories" indicates that I am not expected to present you, in historical sequence, an account of what has transpired in the typewriter world since the introduction of the first marketable machine in 1875; I would, however, state that no sooner had the typewriter acquired a commercial value, than the fire of inventive talent was awakened in Europe and America, and typewriter after typewriter appeared on the market—a few came to stay, but the many disappeared, either during or shortly after the chrysalis or experimental stage had been passed. Inventors and investors have learned, to their sorrow, that hasty innovations and untried experiments spell "failure" in the typewriter field, and only patient and careful study, backed by experience, tireless effort, and abundant resource, have a chance of success.

In the spring of 1888 a valuable paper entitled "Typewriters and Typewriting" was read before this Society by Mr. John Harrison. A perusal of this paper shows that the number of machines then seeking the patronage of the

British public totalled six, viz., "The Caligraph," "The Columbia," "The Hall," "The Hammond," "The Remington," and "The World." Of these only the Remington and the Hammond are to-day on the active list.

In the spring of 1894 Mr. Henry G. Jenkins delivered two Cantor lectures before this Society on "Typewriting Machines." The first traced the evolution of the machine from 1714 to 1875, and the second dealt with developments from 1875 to 1894. The second address makes reference to sixteen machines as being then on the market, viz., "The Bar-Lock," "The Caligraph," "The Columbia," "The Crandall," "The Densmore," "The English," "The Fitch," "The Hall," "The Hammond," "The Maskelyne," "The Munson (now Chicago)," "The Remington," "The Smith Premier," "The Waverley." "The Williams," and "The Yost."

Thus, in the six years which elapsed between the delivery of these lectures, an increase of ten different machines has to be recorded, and of the sixteen machines referred to by Mr. Jenkins only eight survive, viz., the Bar-Lock, Densmore, Hammond, Chicago, Remington, Smith Premier, Williams, and Yost.

Since 1894 an addition of thirty-two machines can be ecorded, making in all forty-eight different instruments. Of these twenty remain on the market. I would point out that scores of machines have appeared on the American market, but my list takes cognisance only of those offered commercially on the British market.

Naturally many changes of the details of construction, tending toward a greater ease and convenience of operation, strength, and durability have been embodied in machines, especially those first introduced and referred to in the two lectures before-mentioned.

"Modern Typewriters" may be defined as billing, tabulating, book recording, card indexing, and document writing machines. They are speedier and produce finer and more varied work than their predecessors.

The manner in which the typewriter performs its work is of the simplest. For the benefit of those present unfamiliar with the typewriter it may be considered as composed of three general parts, as follows:—

The Keyboard, by which the operation of the machine is directed.

The Type Mechanism, by which the desired letters are, one after the other, in any desired sequence, imprinted upon the paper.

The Carriage, which holds the paper in proper position for writing, and which, by its regular movements, provides for the spacing of letters and lines.

A very brief examination of the machine will serve to make the novice familiar with these general parts and the absolute simplicity and directness of their relation to one another.

For illustration and explanation I have selected the "Remington"—which may be considered the pioneer of writing machines. Some of the favour this machine has met with may, no doubt, be attributed to the prestige of priority, but this alone would not account for its widely extended use. The fact that the manufacturers are always ready to introduce alterations which tend to improve, will account in a great measure for its popularity.

The "Remington No. 2" was used by Mr. Harrison to illustrate his address in the spring of 1888. In the autumn of that same year the No. 5 model was introduced. It was similar in the main lines of its construction, but its working capacity was increased by the addition of four more keys equivalent to eight extra characters. It was for many years the favourite writing machine in this country, for which it was specially designed.

In appearance it is square, and strikes a novice as being somewhat complicated. It is only the multiplicity of parts, however, which creates this impression. The machine is not complex, the same parts being repeated over and over again. The action is simplicity itself.

The machine is quite open on every side, so that its entire construction can easily be seen. There is a japanned iron frame enclosing and holding the working parts, consisting of a base, four upright posts, and a top plate. In front is a series of keys arranged in four banks like the keys of an organ, each key representing the two characters, termed "upper" and "lower" case letters. These are connected with long light wooden levers, which, being depressed, communicate motion by means of a rod fastened to the lever to a type bar. At the end of each type bar is fixed the hard metal type representing the two characters. The type bars are arranged in a circle, therefore the point of percussion of the type on the paper is at a common centre. The inking is done by a ribbon, which travels automatically across the machine, winding and re-winding on and from spools.

The paper is inserted between two rollers; one of rubber, called the "paper cylinder,"

and the other of wood, called the "feed roll." The rollers are held together by two elastic india-rubber bands. As one revolves so does the other. The portion which holds these rollers is designated the "carriage." By a clever yet simple piece of mechanism this carriage is caused to travel, simultaneously with the return of the type or spacing bar, from right to left, the width of a letter at each movement, across the machine. The carriage works on a sliding frame, and this sliding mechanism is controlled by two keys which do not impress letters on the paper. These correspond to the silent but important "combination stops" of an organ. They change the character of the printing keys, causing them to print capitals or small letters, numerals or other marks at will. Depress the key marked "upper case" and all the keys will print capitals; remove the finger and they all print small letters again. Moreover, the machine can be arranged to print capitals continuously by the mere raising of a lever, and quite independently of the "upper case" shift key.

To obtain an impression the required key is struck lightly, and the type bar causes the type to strike against the ribbon; thus leaving an imprint upon the paper held round the cylinder; the carriage moves automatically the width of a letter, and the operation is repeated until a word is completed. Then the "spacing bar" at the front of the machine is depressed at any point, thereby securing the requisite space between the words.

When the end of a line is reached, warning is given by the ringing of a bell, and then, by pulling out the lever at the right hand side of the carriage and gently pressing to the right, the paper carriage is advanced into position to receive the next line. The distance between the lines and the width of the writing can be regulated. The paper-carriage being hinged at the back allows of its being raised from the front by the hand so that the line just written can be inspected.

The motive power is imparted by an adjustable coiled spring, a thin leather strap being fastened to it and the carriage, and the uniform space is governed by two clutches working on a rack. This rack is fixed on a rocking shaft, and derives a swinging motion from a universal bar fixed beneath the light wooden key levers.

In the machine under review—Remington No. 5—a small lever attached to the left of the carriage places its movement under the control of the operator. Two scales are fixed on the machine, and these, in conjunction with a pointer, permit of headlines being centred, corrections made, &c.

It will be opportune at this stage to turn attention to machines in general. "Modern Typewriters" may be classed under two heads, viz.: Type-bar machines, and Type-wheel machines. The "Type-bar" machines have the type on the free end of bars arranged in a circle or a semi-circle, the point of percussion of the type on the paper being at a common centre. This class of machine embrace by far the largest number of modern typewriters. To this class belong the Bar-Lock, Densmore, Empire, Fay-Sholes, Fisher, Ideal, Monarch, Oliver, Pittsburg-Visible, Remington, Salter, Smith Premier, Underwood, Williams, Yost.

The "Type-wheel" machines have the type arranged on the periphery of an oscillating shuttle or wheel. To this class belong the Blickensderfer, Hammond, Munson (now "Chicago").

The inking of the machines comprising the two classes is accomplished generally by a ribbon, but in some machines a pad is employed.

In some machines a special key and its accompanying mechanism is provided for each character or sign used — such are termed "complete" keyboard machines. In others, each key is made to represent the letters or signs—such are designated "single-shift" machines. Others, again, have two shift-keys, and each key represents not only a lower case (small) and an upper case (capital) letter, but a figure or other sign as well—such are known as "double-shift" machines.

The time at my disposal this evening will not allow of my describing in extended detail each of the twenty typewriters seeking the public patronage. I will, to the best of my ability, put you in possession of the chief points of each as briefly and succinctly as possible. With this object I have arranged the two classes of modern typewriters into three groups, viz.:—

"Blind" writers, in which the writing remains hidden until exposed by manipulative effort of the operator. "Semi-visible" writers, which show only the last lines, or only expose the centre of the paper, hiding the writing at both ends of the line. "Visible" writers, which expose a character directly in front of the operator the instant it is imprinted, and which subsequently does not pass out of

sight, by feeding behind a scale or bar, or other obstruction. This classification and grouping is for convenience only, and is in no way intended to denote superiority.

the carriage, and can be turned forward or backward at will. The ribbon movement is improved and works entirely automatically, reversing and giving a lateral movement. The marginal stops also are improved, and simple means provided for writing outside the margins whenever desired. There is a keyboard lock, locking the types at the end of the line, and thus preventing one letter being printed over another. A new variable line spacer is embodied which makes it easy to write at any point on the paper, and prolongs the life of the platen for the reason that the type no longer strike in unchanging grooves. An adjustable side guide for arranging the paper to any desired marginal indentation is a recent addition. A new two-colour ribbon lever bearing a disc which signals the colour which the machine is adjusted to write is another recent addition.

TYPE-BAR MACHINES.

Name.	Position of paper-carriage.	Style of keyboard.	Method of inking.	Automatic ribbon reversal.	Strike of type-bar.	Position of writing.	Tabulator.
Remington......	Top (central)	Single-shift	Ribbon	Yes	Upward	Hidden	Accessory (decml)
Densmore	,,	,,	,,	,,	,,	,,	,, ,,
Fay-Sholes......	,,	,,	,,	No	,,	,,	Built-in (stop)
Smith Premier ..	,,	Complete	,,	Yes	,,	,,	Accessory (decml)
Yost	,,	,,	Pad	—	,,	,,	,, ,,
Bar-lock	Rear (bottom)	,,	Ribbon	Yes	Downward	Visible	,, (stop)
Bar-lock	,,	Single-shift	,,	,,	,,	,,	,, ,,
Salter	,,	,,	,,	No	,,	Semi-visible	Nil.
Underwood	Top (rear)	,,	,,	,,	Forward	Visible	Built-in (stop)
Monarch	,,	,,	,,	,,	,,	,,	,, ,,
Ideal	,,	,,	,,	,,	,,	,,	Built-in (decimal)
Pittsburg-Visible	,,	,,	,,	,,	,,	,,	Nil.
Empire	Rear	Double-shift	,,	,,	Horizontal	,,	,,
Oliver	Central (bottom)	,,	,,	,,	Central (down)	Semi-visible	,,
Williams........	Central (top)	Single-shift	Pad	—		,,	,,
Fisher	Flat platen at base	,,	Ribbon	—	Downward	Visible	Built-in (decimal)

TYPE-WHEEL MACHINES.

Name.	Position of paper-carriage.	Style of keyboard.	Method of inking.	Automatic ribbon reverse.	Position of writing.
Hammond	Rear (bottom)	Double-shift	Ribbon	No	Visible
Blickensderfer	,, (,,)	,,	Pad	—	Semi-visible

THE REMINGTON.

I have previously stated that many changes of the details of construction, tending toward strength, durability and a greater ease and convenience of operation has been introduced into the machines which have survived the severe test of time. This is especially the case with the Remington. I have only time to refer to the most important of these valuable improvements. They are:— An entirely new form of escapement, giving increased speed and an easy touch. The carriage is stronger and lighter, and steadier in all respects. The annoying rubber bands which guided the paper round the platen have been discarded for a new form of paper guide which can be adjusted to any desired point. The paper feed has been so arranged as to render it possible to write on wide or narrow paper, and this can be fed into the machine by a simple movement of the hand without lifting

The No. 8 group of Remingtons permit of the interchange of smaller size carriages being readily substituted for the regular size carriage.

Both the No. 7 and No. 8 group of machines

can be fitted with a decimal tabulator, double circular line scale, &c., for billing or tabulating purposes.

Densmore.

The keyboard is the standard "single" shift, with the addition of a lock-key and a back-spacer key. Two uniform shift keys are provided, either of which will shift from small letters to capitals, or the reverse.

The back-spacer key for each depression causes the carriage to move backward one space, enabling the operator instantly to print a faint letter over again, to cover an error, also numbers can be added and the total written in from right to left by striking twice after writing the figure of each column.'

Each type-bar, in addition to a wide bearing, has a supplementary lever, which receives all the strain from its connecting rod, and is protected from wear by ball bearings, each side of the joint containing five hardened steel balls, secured by an ingenious hollow nut, absolutely avoiding lateral play.

The ribbon movement has both a longitudinal and lateral direction, is provided with an automatic reverse, and can be instantly thrown out of gear for duplicating purposes. The writing is brought into sight by tilting the platen forward, which platen is instantly removable.

The justifier is one of the original features of the latest model. It is a gauge with which the paper can be moved to the left any fraction of a full space. It is useful in contracting a word to fit a desired place, *e.g.*, *them* can be substituted for *him*.

A graduated marginal guide on the paper table is provided to insure uniform margins upon the pages.

Variable line-spacing is secured by giving an inward pressure on to the right hand thumb wheel—the machine continuing with the regular spacing from the exact point where the platen is stopped. Line locks, marginal stops, &c., are provided to cover such adjustments and conveniences as are known in practical typewriting. The ordinary carriage of the policy, brief, or draft models can be removed and any smaller size carriage substituted.

Fay-Sholes.

The essential features of this machine are two in number. It is a "single" shift machine, but the depression of the shift-key does not affect the carriage in any way, but shifts the whole of the type-basket, which is brought forward on ball-bearings. If it is desired to print all capitals the basket is shifted and automatically locked, and upon being released returns to its original position for small letters, and is also locked in this position. It is claimed that the result of this arrangement is that all the writing parts are kept in the proper relation to each other, thereby maintaining perfect alignment. The second feature is that five interchangeable carriages for billing, statement, pay-roll, inventory, insurance, or other special work, may be fitted to any Fay Sholes.

The ribbon is not automatic in the reverse movement—there is, however, a "reverse ribbon" signal provided in the form of a key-lever lock, thus attracting the attention of the operator. The act of reversing the ribbon exposes a fresh track or ribbon surface to the type. Each machine has a built-in tabulator for column writing or paragraphing. The machine is provided with the usual devices for writing on ruled lines, and for changing the depth and width of the line spacing, &c.

Smith Premier.

This machine is a very prominent member of this group. There are now on the market six models of the Smith Premier, although they resemble each other entirely in their mechanism, and differ only in the carriage arrangements, or the number of characters. The machine is particularly simple in construction, and claims, by means of a very long and strong adjustable bearing, to have secured a perfect and permanent alignment. The type-bars work on hardened steel bearings, $1\frac{5}{8}$ inches apart, and the type-bars are the shortest of any on a "complete" keyboard machine. But the original and exclusive feature of this machine is the rocking shaft, which replaces the usual wooden or metal key-lever. This consists of a circular rod, passing from the front to the rear of the machine—one rod for each key. Projecting from each shaft is a small bar, which is attached at the front end to the lower portion of the key stem. A similar projection is attached to the rod communicating with the type-bar, and the result is that on the depression of the key the rocking shaft is made to revolve slightly and so raise the free end of the type-bar to the printing point. The type-bar hangers are solidly rivetted to the type ring. It will be seen that matters are so arranged that the amount of force to imprint the characters is precisely the same in every case: a uniform, light, and elastic touch. A very noticeable

feature is its quietness in operation, due to the rigidity of its parts, and the fact that the ball-bearing principle is adopted wherever it can be used to advantage. It is also equipped with a circular brush, built into the machine, into which a handle can be immediately inserted, when, with a turn or two, the whole of the type can be cleaned.

Another point is that the platen is merely rocked forward to bring the work into sight. The platen can be removed immediately, carrying the work with it, and another platen substituted. The carriage is mounted on ball bearings running on hardened steel rails inside the carriage frame, which constitutes a practically frictionless bearing, while holding the carriage perfectly rigid against side motion.

The most striking recent development is the adoption of a three-colour ribbon device. A simple movement of the lever in front of the machine brings the required colour into place ready for use. A two-colour or single-colour ribbon may be employed, if desired. The ribbon can be instantly shifted from the printing point for duplicating purposes. The ribbon reverses automatically, and it is attached to the spools by clamps—one on each spool, dispensing entirely with pins and tapes.

The No. 9 model is fitted with four interchangeable carriages of various sizes, and it prints 96 characters; 84 are provided on the other models, excepting No. 2, this has 76.

The Yost.

The Yost possesses three distinguishing features. These are primarily—1. The ink pad. 2. The centre guide. 3. Great beauty of work.

The ink pad consists of a circular metal case, fixed round the top of the type-basket, against which the type rest. This pad is charged with moist ink, sufficient for continuous writing over a long period. This ink is imparted direct on to the paper by the act of printing.

The type-bar is a very peculiar and remarkably clever contrivance, not taking a direct sweep upwards as is generally the case, but is set loosely in its bearing. Any wear, therefore, can in no way affect the alignment, as the type-block strikes upward through a small hole in a guide plate. This hole is just large enough to allow the type to strike through without any play, and is so shaped as to conform to a bevel on the type-block, so that no friction can arise. The result is that, whether one thin sheet or a dozen thick sheets are in the machine at any time, the alignment is in no way affected. The touch is remarkable for its lightness, in view of the compound leverage adopted in the type-bar action.

The No. 10 standard model prints 85 characters, a separate key being provided for each character, yet the keyboard is conveniently condensed, being arranged in straight lines, vertically and horizontally. The carriage can be lifted bodily away from the machine, carrying with it the work that may be in process of execution, and can be replaced without the slightest danger of shifting the paper. To remove and replace the carriage is the work of a few seconds.

Very useful features are the facility with which type-blocks and buttons can be removed and others inserted for either temporary or permanent purposes, and the holes in the paper blade for ascertaining when the bottom of the paper is being approached. By pressing a spring the platen can be made to turn either backwards or forwards for typing on any desired position on the paper.

The large machines can be fitted with interchangeable carriages of smaller size. Any Yost can be fitted with a decimal and £ s. d. tabulator and invoice day book device, or a two-colour attachment.

The Bar-Lock.

This machine was placed on the market in 1888 and inaugurated a new era in typewriter construction—that of "visible writing" and a "complete universal keyboard"—ideas which have been largely followed by subsequent inventors. Many other ingenious and valuable devices, now generally adopted, originated in this well-known machine. In 1904 its manufacturers placed on the market a "single-shift" keyboard machine provided with 42 keys printing 84 characters; but machines are obtainable equipped with 45 keys printing 90 characters.

The type-bars are balanced upright in two half-circles on wide right-angle adjustable bearings, the front or lower half-circle containing the small or "lower case" letters, and the upper half-circle the capital or "upper case" letters, numerals, commercial signs, and a portion of the punctuation marks. The free end of the type-bars descend to print; thereby, every letter as written is in full sight of the operator.

The machine derives its name from a semicircle of phosphor bronze conical pins fitted in a plate at the printing point, so that every

type-bar, in descending to print, passes between two of the pins and is locked against side-shake or vibration, thus preventing the letters printing out of the straight line. As a further check upon the alignment, each type-bar is fitted with an adjustable truncated cone bearing, which can be tightened up if the bearing by long wear should become loose.

When the type-bar descends, the ribbon is moved so as to be over the line of writing, but directly the type-bar ascends, the ribbon moves back, thereby the writing is completely visible.

The machine is equipped with the following: Automatic ribbon reverse. Automatic right and left marginal devices. Keyboard locking and release key. Automatic paragraphing device. Interchangeable ribbon spools. Switch for throwing ribbon out of gear when stencilling. (At the side of machine on complete keyboard; below key-levers on shift-key machine.) Removable platen roll without taking the carriage off the machine or undoing any screws (useful in manifolding). Accountant attachment (accessory).

The Salter Typewriter.

The "Salter" typewriter is manufactured at West Bromwich, near Birmingham. The machine is the only typewriter made in Great Britain. A few chief points of excellence in the "Salter" are:—Perfect alignment, which is secured without the use of centre guides or complicated type-bars. Direct action from the finger key to the printing point. The type-bars are of specially designed girder section, stamped under enormous pressure from steel, they are, therefore, absolutely rigid. The keyboard contains 28 keys, which, with two shift-keys, gives a total number of 84 characters. The carriage escapement is constructed of steel, with very few parts. It is rapid, simple, and reliable.

The "Salter" is a semi-visible writer. The ribbon has an automatic reverse movement of simple but very ingenious design. By reason of the direct "downstroke" action of the type bars, and the sharp clear face of the steel type, the cutting of stencils is a good feature.

George Salter and Co., have been manufacturing typewriters for some twelve to fourteen years, and their present model proves that a first class instrument can be produced in Great Britain by British workmen.

Underwood.

This machine is built on the front up-stroke principle—each key lever on depression rocks forward a vertical connecting stud lever, the stud of which operates in the link of the type-bar, causing the free end of the latter to rise with a gradually accelerated movement to the printing point. Each key-lever is fitted with an independent adjustable tension, a feature which permits of varying degrees of touch without affecting the speed of the escapement action. This is useful in the "non-visual" system of manipulation in which the outside keys are operated by the little fingers, and these being weak need a lighter depression of the keys than the centre ones which are depressed with the strong index fingers; or, again, in increasing the amount of force required, say to prevent the punctuation marks piercing the paper or indenting the platen.

The alignment is secured by the type-bar swinging at its base through a slot at the bottom of the segment plate, and by a "V"-shape guide at the printing point—the type-bar while printing is thus held rigid at each end, although it is flexible while in motion. The type-bar is arrested by a projection on the segment, which prevents the type from puncturing the cylinder or perforating the paper should the force of the blow on the key be in excess of that required. The characteristic formation of the type-bar renders it impossible to batter the face of the type by striking one against the other.

Another feature is that each type-bar is quickly removable and another bearing different characters, may be substituted and this without affecting the alignment. The up-stroke principle ensures absolute visibleness of the text. The keyboard is a "single-shift," and arranged on the Universal style, with the shift-key in duplicate.

The inking is accomplished by a ribbon winding on and from two side spools, and carried through a frame across the printing point. A bi-chrome ribbon attachment can be fitted, by the use of which the ribbon can be adjusted for stencil purposes. A built-in stop-tabulator forms an integral part of the machine—a feature of this device is a leather brake acting on a rocking stop-rack at the back of the machine. All the usual conveniences for practical typewriting are provided.

The Monarch.

This machine embodies the front up-stroke principle of construction, retaining the well tried pivotal bearing. Uniformity of stroke is secured by a shifting or rolling ful-

crum, which gives an extremely light and elastic touch. The key-lever and type-bar mechanism is so balanced that it ensures a very rapid return—the bar will return to its resting point even without the assistance of springs. The writing is wholly visible. The keyboard is the standard "single-shift," the shift-key being in duplicate and conveniently placed. In addition there are two supplementary keys, one the shift-lock for capitals, and the other a tabulator key, a stop-tabulator forming an integral part of this machine.

The type-bar segment, which responds to the depression of the shift-key, has a vertical shift working on race ways in which are placed roller bearings—this allows of the introduction of a rigid carriage, which also runs on race ways and roller bearings. These race ways are adjustable for the purpose of taking up wear. The ribbon movement is from two side spools. The fabric is carried through a guide at the printing point. One colour or two-colour ribbons can be used, a switch enabling the change to be instantly effected from one colour to the other. The ribbon has three separate movements, end to end, automatic reverse, and a serrated or sinuous travel across its width, but when writing with a parti-colour ribbon the fabric is used straight along its length.

Other special features are a combined carriage feeding attachment and line indicator—this enables the typing to be executed from the extreme top and bottom edges of any size of card; there is also a plate which presents a flat surface for purposes of erasure.

I am informed that the latest development is a contrivance for automatically indicating when the bottom edge of the sheet is being approached. The Monarch is fitted with all necessary conveniences for line locking, margins, margin release, variable and fixed depths of line spacing, &c.

The Ideal.

The Ideal typewriter is manufactured at Dresden, Germany, and is really an ideal machine in more than name. It is a type-bar machine, each bar being made of steel formed in a "U" shape, giving lightness and rigidity. The alignment is secured in a three-fold manner, viz., by a directly-guiding lever, by a type-bearing guide at the base, and a type-lock at the printing point. The blow of each type-bar is positively controlled, any excess being received by a steel check, thereby reducing to a minimum the wear and tear of type, ribbon, and cylinder. As all the type-bars strike from one side, the alignment is not affected by increased thickness of paper being used when manifolding. The writing is absolutely visible. The ribbon movement is not wholly automatic, but the ribbon can be easily removed and replaced. The machine is fitted with a back-rack space operated by a key conveniently placed immediately above the left shift-key, also a variable line-spacing device. The bottom edge of the paper can be determined, the operator being able to see at a glance, at all times, the exact amount of paper available.

An accessory is a simple and efficient and decimal tabulator, which instantaneously places units under units, tens under tens, and hundreds under hundreds, or £ s. d. in their correct relation one to another with the same ease and rapidity as ordinary pen-writing.

Pittsburg Visible.

This machine is constructed on the front upstroke principle—the type-bar striking on the front of the platen, thereby securing absolute visibility of the text. Each type-bar moves in an individual guide and each type-block enters a central guide at the printing point.

The keyboard is a "single" shift, composed of 40 keys. A distinctive feature is that the entire type action—including both type and keys—are interchangeable. Different languages can be used on the same machine; the insertion of an entire type section in place of another can be instantly accomplished. The type is easily cleaned.

The ribbon winds on and from two side spools, passing through a guide at the printing point. The type strikes the ribbon between its centre and upper edge. Therefore, when the colour from the top edge is exhausted, by turning the opposite edge the unused half is brought into service. It lacks an automatic reversal action.

Another feature is that the carriage can be removed for cleaning and oiling purposes. Machines built with a wide carriage can be equipped with an additional carriage of smaller size on the same base. The machine weighs complete, with base board and metal cover, 20 lbs.

The Empire.

The Empire is a machine of original design. The movement is a straight direct thrust, effected by the simplest system of leverage. The depression of the key-lever, which works on a central fulcrum, puts in motion a pivoted

connecting bar, which in its turn drives forward the type-bar, the return being effected by a comb spring acting on the key-lever. The keyboard consists of 28 keys, each representing three types, making a total of 84 characters, which are brought into position severally for small letters, capitals, and figures, by means of two shift-keys.

Features:—Carriage at back. Platen roll interchangeable. Line lock. Compact and portable; weight, with travelling cover, about 24 lbs.

The Oliver.

The Oliver differs in mechanical principle from other machines. It has a wide "U" shaped steel type-bar, provided with a tool steel axle as broad as the bar is long, and brazed joints insuring the alignment without guides. The connection between the type-bar and the key-levers is direct and perpendicular. The type-bars strike down upon the platen in a line perpendicular to its plane, thus transmitting the maximum power with the minimum resistance, and further, maintaining the alignment with several sheets as with one. The type are of steel, and lie face upward—very convenient for cleaning. The keyboard is the "Universal"—the No. 3 model having 28 keys with a "double" shift, giving 84 characters, and the special model 32 keys, giving 96 characters.

The tension and depression of the keys are light and uniform. It might also be noted that the type blocks decrease in weight with the increase of length of type-bar—necessary to secure a uniform stroke The escapement mechanism is exceedingly simple and positive, and although very rapid is almost frictionless. The writing is semi-visible. The carriage is provided with three paper feed rolls, thus ensuring a perfect feed of the paper down to the bottom edge of the sheet. It runs on anti-friction travellers on guide rails, ensuring an easy and steady motion. It is equipped with all the necessary devices. The line space mechanism operates automatically as the carriage is returned from the left to right for a new line. The machine is compact and portable—weight about 20 lbs.

The Williams.

This machine exposes to view the last two or three lines written, and is, therefore, wrongly classed as a "Visible" writer.

The keyboard consists of 28 keys arranged in three banks according to the standard arrangement. Besides these there are two shift-keys which gives the machine a possibility of 84 characters. The 28 type-arms are each provided with three characters.

The faces of the type, when at rest, are on the surface of two ink pads, in two quadrants. Upon a key being depressed, the corresponding type-arm rises from the ink pad and strikes downward upon the platen, the carriage moving automatically with each stroke from right to left across the centre of the machine.

Alignment is maintained by a double system of guides, each type-arm having an individual guide, and all of the type-arms entering a common central guide at the printing point, which guide also answers for an indicator or pointer for purposes of correction, tabulation, &c.

The paper carriage is between the two quadrants, thus necessitating frames to hold the rolled up top and bottom portions of the paper. It travels on ball bearings on a single rail, a single motion of the hand returning the carriage and turning the paper forward for the next line.

The margin stops, line lock, and margin release are conveniently placed, and the line space gauge provides for four different depths of spacing between the lines. The platen roll is interchangeable. The ink pads can be readily removed for re-inking or for changing kind or colour of ink to another.

The manufacturers offer a No. 6 model equipped with 48 keys and a "single-shift"—in duplicate—fitted with an automatic lock.

The Fisher.

This machine is distinct from the ordinary typewriters in that, instead of the paper travelling across the machine, the machine travels across the paper, the paper laying in a flat or spread out condition. Having this feature, it is possible to write upon a series of sheets of varying heights and widths so as to write partial information on some sheets and whole information on others; thus, in writing an invoice, the sheet beneath it may be a copy for the warehouse, omitting prices, beneath that may be a copy for the factory, omitting the name of the customer and prices, but giving only the number of the order. The writing surface or platen being hinged at the rear, operates to allow of the introduction of a bound book. The book is placed upon a rising and falling table, the platen is brought down upon the open book, and the page to be written on turned over on to the platen. These

machines can be fitted for special purposes with an endless belt of carbon for use with folded forms, which forms are placed over and under the carbon, and after being written upon, are withdrawn from the machine without any handling of the carbon. The writing is in sight: it has a universal spacing mechanism, and the interior of the machine is fitted with an electric light for use where the ordinary lighting is deficient.

The Fisher is mostly used in the booking department for dealing with almost every operation of that department, including the writing of invoice and day-book, statement work, and minute recording work. It is also eminently adapted for tabulated work. It writes upon paper of any width—folded or single—and on the heaviest of cards. Writing on a flat surface, the manifolding capacity is very high, and stencil work can be executed without any creasing or cracking of the stencil, for the reason that the wax sheet lies flat.

This machine is now fitted with an adding attachment that adds any column of figures as written. It will add one column or any number of columns—limited only by the number of recording registers that can be placed on the machine at one time.

The paper can be fed into the machine from a roll or a series of rollers, the carbon being fed through the papers transversely from rolls of carbon on either side of the platen.

The Hammond.

This machine has its type all contained in one piece, and the paper is brought into contact with the type by a spring hammer that gives a uniform blow, irrespective of the energy with which the key is depressed. In the centre of the machine is secured a horizontal guide ring, called the "anvil," round which, under the action of the keys, slides back and forth a light curved plate of vulcanite, known as the "shuttle," containing 90 characters arranged in three rows, each covering an arc of about 120°. The ingenious mechanism by which the momentum of the shuttle is arrested and the impression made is as follows:—Each key, when depressed, lifts the horizontal arm of a driver lever, the vertical arm of which, by means of the driver finger, slides the shuttle to approximately the correct position opposite an impression hammer. The key simultaneously raises a vertical rod, which forms a stop pin, against which a horizontal arm connected with the shuttle strikes, thus arresting the shuttle in exactly the right position properly to print the symbol required. The same key also lifts a trip frame lever, the arm of which depresses an escapement lever, thus disengaging the pawl (connected to the hammer by a hammer lever) from the escapement wheel, and allowing the hammer spring to throw the hammer forward against the type presented by the shuttle, and impress on the paper held by the carriage the symbol desired. The inking is done by a travelling ribbon, and the blow of the hammer is distributed over the character by a rubber strip, while a thin metal mask with a central hole is provided, which prevents more than the intended symbol from being touched by the paper at each impression.

There are thirty-three keys arranged in two rows in a convex curve; two are used for lifting the shuttle-guide so as to bring any row of characters to the printing level, and a third for spacing between the words. The paper-holder is moved transversely by a spring that is re-wound by the return movement of the carriage, and is released for each letter by an escapement. The carriage is open at both ends, permitting of any width of paper being inserted with the greatest facility, the length of the written line only being limited.

The advantages offered by the "shuttle" principle of construction as embodied in the "Hammond" are visibility of the text, interchangeable type, and perfect permanent alignment. It is only necessary to be provided with different shuttles to be able to change the style whenever it may be desired; this is a simple and speedy operation. The manufacturers furnish upwards of over 200 different styles of type-shuttles in over 38 different languages, such as Greek, Hebrew, Arabic, German, Russian, Esperanto, &c., also a special Braille shuttle for the blind.

As in other modern typewriters, the depth between and length of lines are variable, while the facilities for making corrections and alterations are excellent. The tension of the main spring and hammer are adjustable for manifolding and stencilling.

The Hammond is made in two varieties, termed the "Ideal" and the "Universal." They differ only in the arrangement of the keyboard. The "Ideal" is semi-circular, and is to be preferred for the reason that it locates characters most frequently used in the centre of the shuttle, thereby increasing the speed and lessening the amount of wear. The

"Universal" has the standard or universal keyboard.

Features.—Double faced hammer, variable line spacer, back spacing device, bi-chrome ribbon. I am informed that developments in the near future will include a built-in decimal tabulator and a carriage to letter space either way, useful for western and eastern languages.

Blickensderfer.

The 84 types in this machine are set round the circumference of a wheel—there are 30 keys, two being shift-keys, one for "capitals" and the other for "figures, &c." The type-wheel can be changed in an instant for one of another style or language—over eighty-five styles are manufactured, covering ancient Greek, modern Greek, Servian, Russian, &c.

The type being in one piece, the relation of one letter to the other must always remain the same, and, therefore, the alignment remains unvaried after wear or when manifolding.

The inking device is a small ink roller swinging on a simple horizontal joint, which passes over the face of each character as it is presented to it.

The force of the impact of the type-wheel on the paper is dependent upon the operator, but whether light or heavy, a clean, sharp impression results, which imprint is semi-visible.

The line-spacing arrangement allows of any desired space between the lines from a hair-breadth to the full stretch it is capable of—thus the depth can be adjusted to suit ruled paper.

The free carriage is a convenience—it can be moved in either direction without releasing a catch or pulling against a tension spring. Different widths of carriages are obtainable. The machine is easily portable—the No. 7 (foolscap) when fastened down to a baseboard, weighs approximately 12 lbs.

Accessories.

The tendency of the times is to employ the typewriter whenever it is possible to do so. Special devices are from time to time invented to meet these extended uses. The most important of recent applications is to counting-house work for billing and book-keeping; this work alone has necessitated important modifications. In this direction the tabulator calls for review. The lack of a practical method enabling tabular matter to be typed with a rapidity equal to that of ordinary typing has long been felt to be a deficiency in typewriters. The invention of the tabulator has enormously increased the scope of the machine in this direction.

The tabulator is a device by means of which figures or words can be written in columns, without employment of the space-bar or carriage release lever, or any adjustment whatever of the carriage by hand. By its use the carriage may be set automatically at any point that may be required. At present this device is an accessory to most machines, but in the near future it *must* form an integral part of all machines, and further, enable the carriage to be automatically placed in a proper position to write numbers in correct relation to each other in columns, *i.e.*, units under units, tens under tens, and so on. The built-in tabulators of to-day, with but two exceptions, are deficient in this respect. The tabulator in either form does not interfere with the use of the machine for other work, such as correspondence, &c.

The tabulator was followed by the introduction of a bi-chrome (two colour) ribbon, and quite recently the Smith Premier Typewriter Company have advanced still further in this direction by introducing a tri-chrome (three colour) ribbon. By a simple movement (previously explained) it is possible to vary the colour of the impression instantaneously, so that credits, marginal notes, foot notes, and underscoring may be indicated in red or other colour preferred. One colour ribbons can be used if desired.

The machines embodying the parti-coloured ribbons and tabulator devices are generally known as "Invoicing" machines, and by simple arrangements, every phase—not only of correspondence, but also of counting-house and statistical work—can be accomplished, with an enormous saving of time. Items can be made on sheets which may be taken from the machine with absolute certainty that when re-inserted the subsequent entries will fall into their proper places.

The introduction of a perfect form of loose leaf book makes it possible for the day-book entries and invoice to be written simultaneously. The benefits claimed for this system are:—Great saving of time, as the invoice and day-book are written simultaneously. The bulk of the invoice can be written in black ink and the credits shown on the same invoices in red, which ensures clearness. The invoice sent to the customer is an exact duplicate of the entry made in the day-book. There is no waste of time in press-copying the invoice, as the day-book entry is an exact copy. The day-book is

always available for the ledger clerk, as the entries being made upon separate sheets, the posting and writing of the day-book can be proceeded with simultaneously. The type-written matter in the day-book does not occupy more than half the space that is used in an ordinary book written by hand. The loose leaf book affords a convenient means of binding typewritten documents of many kinds.

Card Indexing.

For greater convenience in card-indexing special platens are obtainable, or the ordinary platen can be temporarily fitted with a metal clip. Both can be fitted to or removed from the machine in a few seconds, and the cards can be adjusted in an instant. The increasing use of the card file system for a wide variety of purposes lends special importance to the value of the typewriter for this class of work.

Interchangeable Carriages.

For years the thousand and one wide forms, statements, and blanks common in every business office, have been filled by the pen, the reason being that there was no machine practicable for both wide and ordinary work. The manufacturers of most of the modern typewriters now have models embodying interchangeable carriages, which enable anyone possessing a machine with this improvement to have at the same time a set of carriages from the largest to the smallest, all of which can be used upon one machine. In one or two makes this is additional to interchangeable platens.

In this connection I might mention the titles and approximate sizes of paper accommodated by each of the varying models of modern typewriters. They are :—

Foolscap	approx.	9½	ins.
Draft	,,	11	,,
Brief..	,,	14	,,
Policy	,,	18	,,
Manifest	,,	27	,,

In each style of make and model they differ only in size and in one or two small details of construction necessitated by the greater length of the carriage.

Duplicators.

The value of a mechanical contrivance for the rapid and effective multiplication of copies of documents is, at the present time, so fully recognised, that little need be said by way of introduction.

Duplicating machines have been on the market for several years. Their merits as a time and labour saver have been widely appreciated. From time to time as experience proved desirable, various improvements have been made, and modern duplicators represent one of the most useful devices than can be installed in a commercial or professional office as an adjunct to the typewriter. They will produce from one typescript original up to 3,000 copies, of any size, from a post-card to a sheet of brief, every copy having the exact appearance of an original. As evidence of the truth of this statement, I need only state that the postal authorities specify that such copies must be handed in over the counter of a general or branch office, or at one of the authorised sub-offices, and special attention directed to their nature, to secure admission as a half-penny packet. The value of having at hand a duplicating apparatus of this capacity is incalculable. Not only does it save the time and expense incurred in sending to the printer, and obtaining and returning proofs, but there is the additional advantage of being able to supervise, personally, the work in progress. While there are various makes and styles of duplicators, the main principle is the same throughout.

The original is prepared by the now well-known stencil process, *i.e.*, by writing the matter required with a typewriter on a sheet of waxed paper. The pressure of the type expels the wax out of the paper and leaves openings through which the ink can penetrate In the Roneo rotary duplicator a metal frame supports a cylinder of thin, perforated steel. On the outer surface of the cylinder is stretched a linen ink-pad, and over this is placed the stencil. The pad is inked by a rubber roller resting in an ink receptacle suspended between the two sides of the framework. By means of a simple lever this roller can be brought into contact with the cylinder, and ink is thus supplied as required.

The cylinder is rotated by a handle. Paper fed into the machine is gripped by a rubber impression roller, which presses it against the stencil as the cylinder revolves, and the sheet, perfectly printed, is then automatically discharged on the other side.

The rotary can be fitted with three devices, viz., a simple contrivance which automatically feess the sheets into the machine, reducing hand labour to a minimum; an interleaver, which automatically drops an interleaving sheet as each copy is printed—thus permitting

of the use of highly glazed or very hard paper; a cyclometer for registering the number of copies.

The rotary system is far superior to the hand duplicators in the matter of speed, such a machine will print ten copies while the hand device prints one. There is no lost motion, a copy being printed and discharged at each revolution.

Press-Copying.

Every business man recognises the necessity of copying his typewritten letters. At the present time there are four methods of letter copying in vogue, viz.:—(1.) The letter-book method, damping sheets and screw press. (2.) Roller process, water bath and drying drum. (3.) Carbon paper. (4.) The chemical letter copier. The question to be decided is—which is the best method? In regard to the letter-book method, the great drawback is the difficulty of getting the right degree of moisture. Either too much or too little water is applied, and the result is either a smudged copy or one too faint to be readable.

The roller copiers employ a water bath, and give but little if any improvement in the regulation of the degree of moisture. The copies are wound upon a drying drum to prevent off-setting, and subsequently have to be cut apart for filing purposes.

The carbon process enables the answers to be filed with the original letter. But this method has its shortcomings; often at the last moment a correction is made in the answer, the correction in the carbon copy is overlooked, and hence an unreliable record arises. Again, the carbon may not exactly be positioned, and so a word or two at the margin is easily missed.

The modern chemical letter copier offers distinct advantages over the methods first explained. It consists of a simple machine designed to carry a roll of specially prepared paper. The letter to be copied is laid on the feed board, the handle is turned, the sheet is fed automatically into the machine. This is repeated as often as there are letters to be copied, the machine feeding in the sheet, making the copy and storing it on the roll. As many as ten copies (in succession) can be taken from one original. These are cut off with automatic precision and by one movement of the lever-knife.

It will be noticed that a water-bath and brush, or damping sheets are completely dispensed with; there is no "off-setting" and no drying drum. The copy may be either filed with the letter to which it relates or placed, day by day, in a cover having the appearance of an ordinary letter-book—or two copies can be made of each letter—one for filing and the other for the book. For the book method, the sheets are punched at the binding margin.

This brief survey of "modern typewriters" indicates clearly the conditions necessary to meet satisfactorily the average requirements, *i.e.*:—

1. It should be durable. Every part should be simple and strong and adapted to serve its purpose with the smallest degree of wear. Every mechanical movement must be definite, and incapable of incomplete performance. All wearing parts should be adjustable and interchangeable. The work should be performed by the smallest number of movements on the part of the operator, and these movements should be of the simplest and easiest character.

2. It should possess absolutely "visible" writing. The common-sense way to write easily and speedily is to see what you are writing while you are writing it. To be obliged to stop and lift a carriage, tilt a platen, or peer over or under constructional parts in order to see what has been written, checks both the work in hand and the progress of the thought. The writing should be performed in such a part of the machine as to be most readily seen during progress.

3. The keyboard—on type-bar machines in particular — should be that known as the "Universal" or "Standard" arrangement—an assortment which enables the hands to maintain a fairly regular alternate operation while giving the greatest possible speed.

If shift-keys are dispensed with, the keyboard should be condensed by being arranged in straight lines, up and down, right and left, and with the keys almost "flush" one with the other, so that the fingers can glide easily over the keyboard.

The keys on any style of keyboard should have a light and uniform depression, so that the machine may be operated with the minimum of fatigue, and, further, they should preferably be of a dull or neutral colour and present a concave surface to the finger tips. The resistance or tension should be adjustable at will—preferably independently instead of collectively.

4. The type should present an even and regular appearance, termed "alignment."

A type-bar made of suitable material in the right way is the keystone of typewriter con-

struction, for it must be remembered that a typewriter in the last analysis is but a type-bar (or type-wheel) and its attachments.

In all machinery there is some part upon which falls the greatest strain and wear; consequently, upon the durability of that part rests the life of the machine. In typewriters constructed upon the pivotal principle the greatest strain comes upon the bearing or pivot on which the type-lever or bar swings when moving to and from the printing point. If the bearing is absolutely without play the letters write in a perfectly even, straight line. If the bearing is faulty in design or becomes worn, the letters print unevenly and in a wobbly line.

It is well known to everyone that, no matter how good the quality of steel, all wearing surfaces will, if used continually, show signs of wear, therefore a good bearing should have mechanical means for adjustment to take up slack, caused by wear. To get a rigid bearing it is necessary to provide a wide bearing and a short type-bar.

The devices used to secure alignment are numerous and ingenious. One machine depends upon a wide pivotal bearing and a rigid type-bar; another has a bearing composed of a continuous steel rod, with a type-bar flexible while in motion, and made rigid at the printing point by means of guides; a third employs a wide pivotal bearing, a flexible type-bar and either guide pins or a guide plate at the printing point; a fourth employs a compound type-bar and an indispensable guide at the printing centre, and so on. Some have wide and adjustable bearings, to enable the wear to be taken up. These devices, however, are not the only essentials; the type-bar hangers in machines embodying the pivotal principle need to be rigid and solidly fixed, whilst the paper carriage should be perfectly rigid and present a level and even platen surface for the type to strike against.

5. The type should be capable of being easily and quickly cleaned, and in such a way as not to injure the type or soil the hands. Whether it should be wholly interchangeable depends upon the individual requirements.

Special type and corresponding key buttons to meet the extended uses of the typewriter are available. Manufacturers are, as a rule, in a position to supply promptly characters incidental to any commercial, literary, scientific, or medical work, as, *e.g.*, fractions, accents, and the like.

A device should be embodied for rendering it impossible to batter the face of the type when the type-bars are accidentally struck one against the other, and for preventing the type perforating or puncturing the platen.

6. The mechanism controlling the movement of the carriage should act rapidly and uniformly, and its tension should be adjustable. The carriage should have a sure and regular paper feed and be capable of accommodating any smaller width of paper; also the margin regulators and bell trip should be easily and readily altered. The carriage release should operate both from the right and left hand, and marginal releases and a line-looking device should be provided. A back spacer is a convenience. There should be no complicated mechanism to retard the quick insertion, adjustment, or withdrawal of the paper.

An adjustable left side guide is desirable, since it permits of the adjustment of the paper with absolute accuracy to any marginal indentation—useful in invoicing, card writing, &c. The carriage should accommodate several thicknesses of paper, so as not to crumple the sheets when it is desired to manifold. There should be a device for indicating when the bottom of the sheet is approached.

7. The platen roll should be instantly interchangeable, thereby allowing of a soft substance platen being used for single copy work and a hard one for manifolding. If the hard platen is of reduced diameter, more perfect alignment is secured on machines employing a complete circle of rigid type-bars and a central top carriage.

8. The line-spacing mechanism should be variable, and effected by one movement at all times, *i.e.*, the same movement that accomplishes the line feed should be utilised to return the carriage for a new line. A variable line-spacer is desirable, as such a device renders it possible to write at any point on the surface of the paper. It makes all corrections easy, whether or not the paper has been removed from the machine. The best form of variable line-spacer is that connecting directly on the cylinder independent of the ratchet detent. The life of the platen is prolonged, because the type no longer strike in unchanging grooves; each time the spacer is used the cylinder presents a new writing surface.

9. The ribbon movement (if the machine has a ribbon) should consist of a reliable feeding mechanism, and allow of the fabric being quickly withdrawn, replaced, or adjusted for

stencil work. It should bring the whole surface in contact with the type, and also automatically reverse the endwise travel. The ribbon should be capable of being easily attached to the spools without the aid of tapes and pins.

10. The machine should be as noiseless in operation as possible. Efforts are constantly being made to reduce the noise; rigidity of parts tends to eliminate shake and rattle. Machines differ very much in this particular. The employment of guides to force the alignment introduces metallic contact, and consequent friction and noise.

Before concluding my paper I wish to state that my mind is involuntarily carried back to the evening of May 1st, 1867, when Mr John Pratt, of Alabama, U.S.A. (but then residing in College-place, Camden-town, London) exhibited here and very ably described the construction and manipulation of two models of a very ingenious writing machine he had devised. In the course of the discussion a Mr. W. H. Bonnewell, in reply to the Chairman's request that a vote of thanks be given to this pioneer inventor, rose and said:—

"He hoped it would not go forth that in passing that vote of thanks to the author of the paper, the meeting endorsed the feasibility of the invention which had been brought before them. He would be sorry to throw any discouragement upon an ingenious invention; but having had some experience in these matters, he felt himself compelled to give an adverse verdict upon it. . . . He would therefore say, while he quite concurred in a vote of thanks being given for the great ingenuity displayed in the construction of the machine, at the same time if that vote was to be regarded as a verdict in favour of it, he should feel disposed to dissent."*

This is barely forty years ago, and the wonderful perfection of modern typewriters and their indispensable accessories speak volumes as to their utility and present day popularity; in fact, it is not a question of whether or not to use a writing machine, but rather which machine to use. Collectively, typewriters have scattered untold blessings on all civilised communities; they have created an honourable field of employment for thousands upon thousands of persons, either in offices or in the enormous factories devoted to their manufacture. The Society, by the institution of its typewriting examination in 1891, has done much for the large army of literary pianists by encouraging a high standard of work.

* See *Journal*, vol. xv., p. 384, also vol. xxiv., p. 245, and vol. liii., p. 921.

I thank you heartily for the very kind attention you have accorded me during the delivery of this humble paper, which, from its very nature, is somewhat technical and unattractive; still, if its recital has deepened your intimacy with machines for recording modern thought I feel that I am amply repaid for the time involved in its preparation.

I further desire to publicly thank the various typewriter companies for the valuable and willing assistance rendered to me in preparing and illustrating this paper.

After the reading of the paper there was an exhibition of modern typewriters, kindly lent by the various proprietors.

The following Type-bar Machines were shown:—Remington, Fay-Sholes, Smith Premier, Yost, Barlock, Salter, Underwood, Monarch, Ideal, Pittsburg, Visible, Empire, Oliver, Williams, and Fisher.

Type Wheel machines. Hammond and Blickensdorfe. (See Table, p. 431.)

Duplicators:—Gestetner Rotary Duplicator, Roneo Rotary Duplicator, and Roneo Chemical Copier.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his interesting paper, said that owing to the lateness of the hour it was impossible for any discussion to take place.

The resolution of thanks having been carried unanimously, the meeting terminated.

BRITISH RESULTS AT MILAN EXHIBITION.

It is stated that the Report on the British Section of the Milan International Exhibition of 1906 is now in course of preparation. The comparatively late period of the year at which the various sections were finally completed precluded an early *coup d'œil* of the exhibition as a whole, as well as of the relative importance of the British Section. There were 333 British exhibitors, and to these were accorded no fewer than 340 awards. The particular departments in which Great Britain is now acknowledged to have clearly excelled were the marine, where the ships' models contributed by the great firms on the Clyde and the Tyne attracted deserved admiration, the agricultural and textile machinery exhibits, the latter being a department in which we are likely to hold the premier place for some time to come. In respect of decorative arts, too, it is admitted that we have made an excellent display, especially in furniture, ceramics, glass, lace, jewellery, and engraving. The total number of exhibitors was 12,500, and an area of 250 acres was occupied by the exhibition. There were 5,500,000 of visitors altogether, and the admissions amounted to £175,000.

HOME INDUSTRIES.

Workmen's Compensation.—Most of the insurance companies have agreed to work together in domestic service insurance, and so to maintain adequate premium rates. It is the reasonable course, but it may be hoped that rates, whilst "adequate," will not be excessive. To fix unnecessarily high rates would be to encourage competition of an undesirable character. That occurred after the passing of the mother Act, with disastrous results. Experience is necessary to settle authoritatively the rate at which iusurance companies can safely ensure the domestic servant, but meantime the decision of what may be called the tariff offices as to the rate to be charged for the "casual" servant, such as the charwoman, seems open to criticism. The price asked for indemnity is an addition of 25 per cent. to the total premium, with a minimum of 2s. 6d. This seems excessive. For a servant working throughout the year from morning to night 2s. 6d. is considered adequate to cover the risk, and yet the small householder who calls in a charwoman now and again has to pay 2s. 6d. It is very doubtful whether the Act covers this class of service. It is certain that it makes the employer absolutely responsible for accidents to his regular domestics, but it is by no means certain that he is under any liability for persons only occasionally employed for other than trade or business purposes. At any rate, until the point has come before the Courts, as it must do when the Act is in operation, and claims begin to be made on behalf of the casual, it might be thought that the insurance companies would be content with a lower rate, and even if the Courts read the Act to cover the casual servant, the risk to one employed say upon 25 days of the year, or even 50, must be very much less than that incurred in the case of one employed on the whole 365 days of the year, yet, unless there is revision, it will cost as much to insure against loss upon the one class as the other.

The Profits of Colliery Companies.—At a time when the householder is grumbling at the high price of coal, and ruling rates have been exceptionally high throughout the winter, it may be interesting to note the profits of representative colliery companies, as shown by their balance-sheets for 1906. Eight of them dealing with last year have now been issued, and it would be strange if, in a year in which the export trade showed an excess of 8,433,000 tons over that of the preceding twelve months, and the activity of the iron trade and other industries made the home trade exceptionally good, exceptional profits were not shown. Accordingly the figures are very satisfactory from the coal owners point of view. The eight companies earned an aggregate profit of £464,107, as compared with £278,813 in 1905, the shareholders receiving dividends amounting to £253,338, as compared with £202,288 in 1905. It will be noted that the amount received by shareholders is small as compared with the profit earned, but the proportion is always small in colliery companies. It is, however, much smaller this year than last if the eight companies to whom the figures given above apply are taken as the basis of comparison. Out of last year's profit little more than half, or to be exact 54·6 per cent. goes to shareholders, in 1905, upon a much smaller aggregate profit, they got 72·6 per cent. The justification for the comparatively small proportion of profits distributed by colliery companies is the many contingencies that have to be provided for. An exceptional instance of the extent to which some colliery companies provide for contingencies is to be found in the case of a company with a share capital of £250,000, and a loan on mortgage for £45,000. There is a reserve fund standing at £45,000, depreciation account £123,983, dividend suspense account £25,000, and suspense account No. 2 £15,000, making a total of £208,983. The one unfavourable feature of the past year, from the point of view of the companies, was the rise in wages, but this increased expenditure was much more than counterbalanced by the rise in prices. The present year promises a continuance of the good times for colliery companies, and it may be hoped that they will not take extreme advantage of the position and so array public opinion ageint them.

Railways and Traders.—The dissatisfaction of traders with railway authorities has just found vigorous expression at a conference convened by the Manchester Committee on Railway and Canal Traffic, at which the following resolution was unanimously adopted:—"That in the opinion of this meeting the combination into which the railway companies have entered violates the conditions on which such companies have acquired their statutory powers, is contrary to public policy, in that it tends to destroy public competition, and is calculated, if maintained, to invest the railway companies with the uncontrolled monopoly of the carriage of merchandise; and this meeting thereby pledges itself to resist the policy of combination by all available means." A second resolution calls upon the Board of Trade to publish the terms of all such arrangements made by any railway companies with reference to merchandise traffic; and a third asks the President of the Board of Trade to receive a deputation, which, among other things, will urge the abolition of preferential rebates and arrangements, especially with regard to foreign imports. There can be no doubt that these resolutions express the strongly-held opinions of a large body of traders throughout the kingdom, but it is pointed out on the other side that there is no new general combination among the railways, but only certain agreements of a local character which aim at the restriction of unnecessary competition. Again, it is urged that even if the alleged combination did exist, the present powers of the Board of Trade, and of the

Railway and Canal Commission, are quite wide enough to prevent injustice being done to the traders, seeing that it is virtually impossible to raise rates, or even to restore those which have been reduced. Whatever the explanation, it is noteworthy that, although Section 31 of the Railway and Canal Traffic Act, 1888, provides that if any trader is of opinion that a railway company is treating him unfairly, or in an offensive manner, he may complain to the Board of Trade, the ninth report of the Board of Trade of proceedings under this section speaks of the "marked falling off" in the number of complaints against the railway companies.

Railways and Traders in Germany.—As bearing upon the above controversy, Mr. A. M. Ackworth lends his high authority to the support of the opinion that the German railways do not give German traders as good accommodation and service as the British trader gets here. The latter may pay more, and it is open to argument whether the extra advantages he enjoys are on the whole worth as much as, or more or less than, the extra price, if any; but these are separate questions on which, in the entire absence of statistical information in England, opinion can only be expressed with great hesitation and considerable reserve. What seems to be admitted is that there is more dissatisfaction with English than with German rates at the present time, and Mr. Ackworth's explanation comes under three heads. (1.) There has been a good many increases in English rates, indirect rather than direct, in recent years, but whilst the German State railways have recently increased their passengers fare very considerably such changes as they have made in freight rates have all been downwards. (2.) Changes in English rates are made privately and (practically) by the unchecked authority of the railways; in Germany only after full consultation with and notice to the districts and traders concerned. Mr. Ackworth is of the opinion that if the Board of Trade would secure the establishment of district and national railway councils on the German model it would confer a great advantage on the traders, and an even greater advantage on the railway companies. (3.) There is necessarily more discontent here than in Germany, because the English system is one of differential competitive rates. The German system is, speaking broadly, one of cast-iron distance rates. The discontent of the English trader, Mr. Ackworth argues, is a part of the price which he must be content to pay for our differential system, without which English trade would be paralysed.

Rubber Supplies.—Great as has been the increase in the demand in recent years for india-rubber, a demand likely to show continuous increase for many years to come, and notwithstanding the coming exhaustion of the available supply from the forests in the Amazon basin in South America, there is not much fear of the demand getting far ahead of the supply in the immediate future. Within a decade the rubber plantations in the Malay Archipelago, Ceylon, and elsewhere, planted in recent years, will be coming into full bearing, not to speak of the immense tracts likely to be planted during the continuance of high prices. And now comes a report from Mr. Dawe, the Government Botanist in the East African Protectorate, who announces the discovery in the forests of Uganda of large tracts where the Lagos silk rubber tree flourishes in great profusion. Mr. Dawe estimates that there are upwards of two millions of these trees on an area of some fifty-four square miles; the rubber being not much inferior in quality to that obtained from South America.

The Increase in the Cotton-spinning Mills.—The *Statist* gives some interesting figures showing the great increase in cotton-spinning mills during the past three years, and their effect upon other industries and wages. In the thirty years, 1870-1900, the increase in the number of spindles was only 6,300,000; since the commencement of the century, that is to say in seven years, the number of spindles in Great Britain has increased by 10,000,000. At the present time, the total number of spindles in France is only 7,000,000, and in Germany, including Austria and Switzerland, roughly 15,000,000. In the first year of the century mill flotation was almost at a standstill. Only four companies were registered, and of these two remained dormant until 1903. The following year eight companies were registered; in 1902 only two were formed. It was not until 1903 that the boom began. In that year ten large mill companies were registered, to be increased in 1904 by 16 other large mill companies; 1905 saw an addition of no less than 40 mill companies. Last year only 20 companies were formed, but the present year already sees 14 new large mill companies. Taking the five years 1903-7, 100 new mill companies, with a nominal capital of £8,330,000, have been formed; nor must the extensions of privately owned mills, representing a large number of spindles and capital, be forgotten. The immense extension of production suggested by these figures has made work for a great army of workpeople, male and female, something like 30,000 persons of both sexes, with an addition in wages bills of about £32,000 weekly for the additional 10,000,000 spindles. This money goes in turn, and for the most part, to shopkeepers, property owners, and places of amusement. The average of comfort is raised, and it may be mentioned that the number of operatives owning the houses they live in in Oldham, the centre of the cotton spining district, is very greatly in excess of the proportion living in their own houses in any other part of the Kingdom. And three out of every five Oldham families have savings invested in the mills they work in.

OBITUARY.

HERBERT MILLS BIRDWOOD, LL.D., C.S.I.—The Society of Arts and its Indian Section have suffered a severe loss in the sudden death of Mr. Birdwood at his residence at Twickenham, on the 21st February. On the 14th ult. Mr. Birdwood attended the meeting of the Indian Section when Sir Frederic Lely read his paper on Famine in India, and at the previous meeting of the Section in the absence of the author, he read Captain Barnes's paper on "The Bhils of Western India."

Mr. Birdwood was the third of five sons of General Christopher Birdwood, some time Commissary-General for Bombay. He thus belonged to the fourth generation of his family in the direct line officially connected with India from about 1760. He was born at Belgaum, in the Deccan, and was educated successively at Plymouth, Exeter, Edinburgh, and Cambridge. He graduated in the latter university in 1858 as a Wrangler, and in the second-class of the Natural Science Tripos. He sat in the first open competition which, in 1858, superseded nomination to Haileybury as a passport to the Indian Civil Service, and at the final examination stood eleventh on the list.

His first judicial charge was in the Konkarie district of Ratnagari, and in 1881 he was elevated to the position of Judicial Commissioner and Judge of the Sudar Court in Sind. He greatly distinguished himself in laying out the People's Park at Karachi, and Dr. John Pollen, in writing respecting Mr. Birdwood's paper on the Province of Sind, bore witness "to the devoted service Mr. Birdwood rendered in connection with the gardens and zoological collections at Karachi. . . . . Wherever he served he used to make gardens flourish, and he stimulated others to follow his example." (See *Journal* vol. li. p. 610.) After acting on three occasions as a Judge of the Bombay High Court, he was made a permanent member of the Bench in 1885, a position he continued to hold until appointed judicial member of the Bombay Government in 1892. He was a syndic of the Bombay University, and in four separate years he was Dean of the Arts Faculty. In 1891-92 he was Vice-Chancellor. In 1889, while home on leave, he took the degree of LL.D., and was called to the Bar at Lincoln's-inn.

Two years before his permanent return to England he acted as Governor of Bombay for a single day on February 17th, 1895.

He was elected a member of the Society of Arts in 1897, and he took great interest in its proceedings. He read a paper in 1898 on the Plague in Bombay, in battling with which calamity he had taken a prominent part. For this paper he was awarded the Society's medal. In 1903 he read the paper on the Province of Sind already alluded to.

A few years ago he obtained the distinction of election to the Honorary Fellowship of his old college—Peter-house. His was a busy life, and in the many occupations he was continually engaged, he gained the esteem and respect of all in whose company he was thrown from his attractive personal character and readiness to help others.

He leaves a widow and four sons, all serving in the Army in India, and one daughter, married to Colonel Stewart, R.A.

GENERAL JAMES MICHAEL, C.S.I. — General Michael, the first organiser of a scheme of Forest Conservancy in India, died at San Remo on the 17th February. He was born on the 2nd January, 1828, and, after commencing his education at Brighton, he studied in Germany, in Switzerland, and at the Military Academy, Edinburgh. He entered the army in December, 1844, as an ensign in the Madras Infantry. In 1848 he was appointed as assistant engineer to organise a scheme of forest conservancy, which he superintended until the establishment of a regular forest department in 1856. He was assistant chief engineer at Hyderabad during the Mutiny, and received a medal and the thanks of the Government of India for his services. On the occasion of the King's (then Prince of Wales) visit to Madras in 1875, General Michael was attached to His Royal Highness's staff. He was Secretary to the Government of Madras, military department from 1876 to 1883. General Michael was also Commissioner for several international and other exhibitions. He was elected a member of the Society of Arts in 1885, and as a member of the Indian Section Committee, he took great interest in the proceedings of the Society. On December 19th, 1894, he read a paper on Forestry, for which he received the Society's medal. In the discussion which followed the reading of the paper, Sir Clements Markham (who presided), Sir Joseph Fayrer, and Sir George Birdwood all spoke in the highest terms of the work done by General Michael for the establishment of forestry in India. In 1898 when a paper was read by the late Sir M. E. Grant-Duff on the "Recreations of an Indian Official," the author in reply to the vote of thanks moved by the Chairman, Lord George Hamilton (who had alluded to the fact that 1898 was the Jubilee year of the great Forest Department of India) said "that General Michael was a very distinguished forest officer and a pioneer of much good work in that direction."

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 6.—"The Discovery of the South Eastern Coalfield." By PROFESSOR W. BOYD DAWKINS, D.Sc., F.R.S. The Right Hon. LORD HARRIS, G.C.S.I., G.C.I.E., will preside.

MARCH 13.—"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc. LEWIS FOREMAN DAY, F.S.A., Vice-President of the Society, will preside.

MARCH 20.—"Smoke Prevention in Factories and Electric Supply Stations." By JOHN B. C. KERSHAW, F.I.C. SIR JOSEPH W. SWAN, M.A., F.R.S., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras. The LORD AMPTHILL, G.C.S.I., G.C.I.E., will preside.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

MARCH 5.—"British Malaya." By SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A. (Oxon), late Resident General Federated Malay States. SIR FRANK SWETTENHAM, K.C.M.G., will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

LECTURE II.—MARCH 4.—Italian examples of Romanesque ornament—Byzantine art and its formation—Patterns suggested by textiles—Arab influence—Byzantine influence in Italy mixed with Lombard—Archaistic stucco work, affected by Byzantine ivories—Classical motifs copied—Decorative arcadings at Venice and Verona.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 4...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. F. Hamilton Jackson, "Romanesque Ornament." (Lecture II.)

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W.. 7½ p.m. Mr. Edward John Stead, "The Connaught Bridge, Natal."

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Mr. C. W. Odling, "Orissa; its History and People."

Chemical Industry (London Section), in the Chemical Society's Rooms, Burlington-house, W., 8 p.m. Prof. R. Trelfall, "Measuring and Testing Producer Gas."

Asiatic, 22, Albermarle-street, W., 3 p.m.

TUESDAY, MARCH 5...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonel Section.) Sir William Hood Treacher, "British Malaya."

Royal Institution, Albemarle-street, W., 3 p.m. Professor W. Stirling, "The Visual Apparatus of Man and Animals." (Lecture IV.)

Alpine Club, 23, Savile row, W., 8.½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. Dugald Clerk's paper, "The Limits of Thermal Efficiency in Internal Combustion Motors," 2. Mr. A. P. Trotter, "The Construction of Overhead Electric Transmission Lines."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Rev. Prof. G. Henslow, "The True Darwinism."

WEDNESDAY, MARCH 6..SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Prof. W. Boyd Dawkins, "The Discovery of the South-Eastern Coalfield."

African Society, Criterion Restaurant, Piccadilly, W., 8 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Mr. J. Corbett, "The Strategical Value of Speed in Battleships."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. The Rev. E. S. Dewick, "Consecration Crosses."

Obstetrical, 20, Hanover-square, W., 8 p.m.

THURSDAY, MARCH 7...Aeronautical Society (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m.

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Miss N. F. Layard, "The Development of the Frog." 2. Mr. S. W. Kemp, "Biscayan Plankton Decapoda." 3. Professor E. B. Poulton, "A Special Point on Colour Adjustment of Chamæleon." 4. Mr. G. Claridge Dance, "New Channel Island Plants."

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. M. Barrowcliff and F. B. Power, "The Constitution of Chaulmoogric and Hydnocarpic Acids." 2. Messrs. H. M. Dawson and C. G. Jackson, "Volume Changes which accompany Transformations in the System $Na_2S_2O_3$: $5H_2O$."

Royal Institution, Albemarle-street, W., 3 p.m. Dr. W. Martin, "Old Dutch Paintings and Painters." (Lecture II.)

Civil and Mechanical Engineers, Caxton-hall, Westminster, S.W., 8 p.m. Mr. C. R. Allensby, "Types of Enclosed Steam Water Heaters."

Electrical Engineers, 25, Great George-street, S.W., 8 p.m., Mr. J. S. Highfield, "The Transmission of Electrical Energy by Direct Current on the Series System."

FRIDAY, MARCH 8...Royal Institution, Albemarle-street, W., 9 p.m. Prof. D. J. Hamilton, "Certain Seasonal Diseases of the Sheep, and the means of preventing them."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. A. T. Arnall, "Corrugations on Tram-Rails."

Astronomical, Burlington-house, W., 8 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Physics Laboratory of the Royal College of Science, Imperial Institute-road, South Kensington, S.W., 8 p.m. 1. Prof. Trouton and Mr. Russ, "The Rate of Recovery of Residual Charge in Electric Condensers." 2. Mr. Pichon, "Experimental Mathematics." 3. Mr. Blakesley, "An Instrument to Describe Families of Equiangular Spirals." 4. Mr. Roberts, "A Micromanometer."

SATURDAY, MARCH 9...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Röntgen, Cathode, and Positive Rays." (Lecture IV.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, MARCH 11, 8 p.m. (Cantor Lecture.) F. HAMILTON JACKSON, "Romanesque Ornament." (Lecture III.)

WEDNESDAY, MARCH 13, 8 p.m. (Ordinary Meeting.) NOEL HEATON, B.Sc., "Mediæval Stained Glass, its Production and Decay."

THURSDAY, MARCH 14, 8 p.m. (Indian Section.) SIR JAMES THOMSON, K.C.S.I., M.A., "The City of Madras."

Further details of the Society's meetings will be found at the end of this number.

EXAMINATIONS.

The Society's Examinations will commence on Monday, April 15.

The last day for receiving applications from Local Committees is Tuesday, the 12th March, 1907, and after that date none will be received under any circumstances whatever. Application forms from the Provinces should therefore be posted not later than Monday, the 11th March. Committees may, however, close their entry lists at an earlier date, if found desirable.

Copies of the Programme for 1907, with full details, together with the questions for 1906, and reports by the Examiners, can be had, price 3d. (post-free 4d.) on application to the Secretary, Sir Henry Trueman Wood, Society of Arts, Adelphi, London, W.C.

The questions for the years 1900, 1902, 1903, 1904, and 1905 can also be obtained (price 4d. each year post-free) on application as above.

CANTOR LECTURES.

On Monday evening, March 4th, Mr. F. HAMILTON JACKSON, Vice-President of the Society of Designers, delivered the second lecture of his course on "Romanesque Ornament."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, March 5, 1907; SIR FRANK SWETTENHAM, K.C.M.G., in the chair. The paper read was "British Malaya," by SIR WILLIAM HOOD TREACHER, K.C.M.G., M.A.

The paper and report of the discussion will be published in a future number of the *Journal*.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

THE ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1907 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before Saturday the 6th April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck

to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S., "for his great services to Arts, Manufactures, and Commerce, in the creation of the penny postage, and for his other reforms in the postal system of this country, the benefits of which have, however, not been confined to this country, but have extended over the civilised world."

In 1865, to his Imperial Majesty, Napoleon III., "for distinguished merit in promoting, in many ways, by his personal exertions, the international progress of Arts, Manufactures, and Commerce, the proofs of which are afforded by his judicious patronage of Art, his enlightened commercial policy, and especially by the abolition of passports in favour of British subjects."

In 1866, to Michael Faraday, D.C.L., F.R.S., "for discoveries in electricity, magnetism, and chemistry, which, in their relation to the industries of the world, have so largely promoted Arts, Manufactures, and Commerce."

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S., "in recognition of their joint labours in establishing the first electric telegraph."

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S., "for the invention and manufacture of instruments of measurement and uniform standards by which the production of machinery has been brought to a state of perfection hitherto unapproached, to the great advancement of Arts, Manufactures, and Commerce."

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For. Memb. R.S., Chevalier of the Legion of Honour, &c., "for his numerous valuable researches and writings, which have contributed most importantly to the development of food economy and agriculture, to the advancement of chemical science, and to the benefits derived from that science by Arts, Manufactures, and Commerce."

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I., "for services rendered to Arts, Manufactures, and Commerce, by the realisation of the Suez Canal."

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B., "for his important services in promoting Arts, Manufactures, and Commerce, especially in aiding the establishment and development of International Exhibitions, the Department of Science and Art, and the South Kensington Museum."

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S., "for the eminent services rendered by him to Arts, Manufactures, and Commerce, in developing the manufacture of steel."

In 1873, to Michel Eugène Chevreul, For. Memb. R.S., Member of the Institute of France, "for his chemical researches, especially in reference to saponification, dyeing, agriculture, and natural history, which for more than half a century, have exercised a wide influence on the industrial arts of the world."

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S., "for his researches in connection with the laws of heat, and the practical applications of them to furnaces used in the Arts; and for his improvements in the manufacture of iron; and generally for the services rendered by him in connection with economisation of fuel in its various applications to Manufactures and the Arts."

In 1875, to Michel Chevalier, "the distinguished French statesman, who, by his writings and persistent exertions, extending over many years, has rendered essential services in promoting Arts, Manufactures, and Commerce."

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal, "for eminent services rendered to Commerce by his researches in nautical astronomy and in magnetism, and by his improvements in the application of the mariner's compass to the navigation of iron ships."

In 1877, to Jean Baptiste Dumas, For. Memb. R.S., Member of the Institute of France, "the distinguished chemist, whose researches have exercised a very material influence on the advancement of the Industrial Arts."

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S., "because of his distinction as an engineer and as a scientific man, and because by the development of the transmission of power—hydraulically—due to his constant efforts, extending over many years, the manufactures of this country have been greatly aided, and mechanical power beneficially substituted for most laborious and injurious labour."

In 1879, to Sir William Thomson (now Lord Kelvin), O.M., LL.D., D.C.L., F.R.S., "on account of the signal service rendered to Arts, Manufactures, and Commerce, by his electrical researches, especially with reference to the transmission of telegraphic messages over ocean cables."

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S., "for having established, after most laborious research, the true relation between heat, electricity, and mechanical work, thus affording to the engineer a sure guide in the application of science to industrial pursuits."

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry, in the University of Berlin, "for eminent services rendered to the Industrial Arts by his investigations in organic chemistry, and for his successful labour in promoting the cultivation of chemical education and research in England."

In 1882, to Louis Pasteur, Member of the Institute of France, For. Memb. R.S., "for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals, whereby the arts of wine-making, silk production, and agriculture have been greatly benefited."

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S., "for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanical Department, he has rendered to the Arts, Manufactures, and Commerce by promoting an accurate knowledge of the floras and economic vegetable products of our several colonies and dependencies of the Empire."

In 1884, to Captain James Buchanan Eads, "the distinguished American engineer, whose works have been of such great service in improving the water communications of North America, and have thereby rendered valuable aid to the commerce of the world,"

In 1885, to Mr. (afterwards Sir) Henry Doulton. "in recognition of the impulse given by him to the production of artistic pottery in this country."

In 1886, to Samuel Cunliffe Lister (afterwards Lord Masham), "for the services he has rendered to the textile industries, especially by the substitution of mechanical wool combing for hand combing, and by the introduction and development of a new industry —the utilisation of waste silk."

In 1887, to HER MAJESTY QUEEN VICTORIA, "in commemoration of the progress of Arts, Manufactures, and Commerce throughout the Empire during the fifty years of her reign."

In 1888, to Professor Hermann Louis Helmholtz, For. Memb. R.S., "in recognition of the value of his researches in various branches of science and of their practical results upon music, painting, and the useful arts."

In 1889, to John Percy, LL.D., F.R.S., "for his achievements in promoting the Arts, Manufactures, and Commerce, through the world-wide influence which his researches and writings have had upon the progress of the science and practice of metallurgy."

In 1890, to Dr. (now Sir) William Henry Perkin, F.R.S., "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of a previously worthless material."

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S., "in recognition of the manner in which he has promoted several important classes of the Arts and Manufactures, by the applicatiou of Chemical Science, and especially by his researches in the manufacture of iron and of steel; and also in acknowledgment of the great services he has rendered to the State in the provision of improved war material, and as Chemist to the War Department."

In 1892, to Thomas Alva Edison, "in recognition of the merits of his numerous and valuable inventions, especially his improvements in telegraphy, in telephony, and in electric lighting, and for his discovery of a means of reproducing vocal sounds by the phonograph."

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S., "for their joint services to scientific agriculture, and notably for the researches which, throughout a period of fifty years, have been carried on by them at the Experimental Farm, Rothamsted."

In 1894, to Sir Joseph (now Lord) Lister, F.R.S., "for the discovery and establishment of the antiseptic method of treating wounds and injuries by which not only has the art of surgery being generally promoted, and human life saved in all parts of the world, but extensive industries have been created for the supply of materials required or carrying the treatment into effect."

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce by his metallurgical researches and the resulting development of the iron and steel industries."

In 1896, to Prof. David Edward Hughes, F.R.S., "in recognition of the services he has rendered to Arts, Manufactures, and Commerce, by his numerous inventions in electricity and magnetism, especially the printing telegraph and the microphone."

In 1897, to George James Symons, F.R.S., "for the services he has rendered to the United Kingdom by affording to engineers engaged in the water supply and the sewage of towns a trustworthy basis for their work, by establishing and carrying on during nearly forty years systematic observations (now at over 3,000 stations) of the rainfall of the British Isles, and by recording, tabulating, and graphically indicating the results of these observations in the annual volumes published by himself."

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For. Memb. R.S., "in recognition of his numerous and most valuable applications of Chemistry and Physics to the Arts and to Manufactures."

In 1899, to Sir William Crookes, F.R.S., "for his extensive and laborious researches in chemistry and in physics; researches which have, in many instances, developed into useful practical applications in the Arts and Manufactures."

In 1900, to Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small, a discovery now used in all dynamo machines; and for its application to the production of the electric search-light, and to the electro-deposition of metals from their solutions."

In 1901, to HIS MAJESTY THE KING, "in recognition of the aid rendered by His Majesty to Arts, Manufactures, and Commerce during thirty-eight years' Presidency of the Society of Arts, by undertaking the direction of important exhibitions in this country and the executive control of British representation at International Exhibitions abroad, and also by many other services to the cause of British Industry."

In 1902, to Professor Alexander Graham Bell, "for his invention of the Telephone."

In 1903, to Sir Charles Augustus Hartley, K.C.M.G., "in recognition of his services, extending over 44

years, as Engineer to the International Commission of the Danube, which have resulted in the opening up of the navigation of that river to ships of all nations, and of his similar services, extending over 20 years, as British Commissioner on the International Technical Commission of the Suez Canal."

In 1904, to Walter Crane, "in recognition of the services he has rendered to Art and Industry by awakening popular interest in Decorative Art and Craftsmanship, and by promoting the recognition of English Art in the form most material to the commercial prosperity of the country."

In 1905, to Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S., "in recognition of the influence which his researches directed to the increase of scientific applications, the production of improved lenses, and the development of apparatus for Sound Signalling at Sea."

In 1906, to Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S., "for the important part he took in the invention of the incandescent electric lamp, and for his invention of the carbon process of photographic printing."

PROCEEDINGS OF THE SOCIETY.

THIRTEENTH ORDINARY MEETING.

Wednesday, MARCH 6th, 1907; The RIGHT HON. LORD HARRIS, G.C.S.I., G.C.I.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Cadell, Alan, C.S.I., Glenmara, Arthur-road, Wimbledon-park, S.W.
Conradi, Henry, 19, Ebbsfleet-road, Cricklewood, N.W.
Davies, Charles J., Milford Haven.
Fuller, George W., 170, Broadway, New York City, U.S.A.
Hayward, William Wyatt, 257 España, Lomas de Zamora, Buenos Ayres, Argentine Republic.
Midhut, Mohamed Hossain Khan, Office of Railway Board, Simla, and Zamania, Ghazipur District, U.P., India.
Myer, Reginald, 8, Ladbroke-square, W.
O'Brien, Hon. W. Turlough, 13, Egerton-place, S.W.
Ogilvie, Alec., 13, Holland-villas-road, Kensington, W.
Silberrad, Ch. A., B.A., B.Sc., care of Messrs. R. Silberrad and Son, 25, Savage-gardens, Crutched-friars, E.C., and Banda, U.P., India.
Testa, F. J., Honolulu, Hawaiian Islands.

The following candidates were balloted for and duly elected members of the Society:—

Aiyar, Narayana P. Hara, Local Fund Engineer, Anantapoor, Madras, India.
Alston, John, 88, Bishopsgate-street Within, E.C.
Clarke, His Honour Judge R. Johnson, 189, Broad-street, Monrovia, Liberia, West Africa.
Harward, Francis Vernon, 83, Dartmouth-road, Cricklewood, N.W.
Healey, Alfred E., 35, Marlborough-hill, N.W., and Constitutional Club, Northumberland - avenue, W.C.
Knowles, George Potter, Assoc.M.Inst.C.E., F.S.I., 39, Victoria-street, S.W.
Rutherford, Hon. A. C., Strathcona, Alberta, Canada.

THE DISCOVERY OF THE SOUTH-EASTERN COALFIELD.

By PROFESSOR W. BOYD DAWKINS, M.A., D.Sc. OXON, F.R.S.

The discovery of the south-eastern coalfield, between Dover and Canterbury, is one of those events which are closely connected with our industrial development, and which promises, in the not very remote future, to bring about the same changes in South Eastern England, as those following similar discoveries in France and Belgium in the nineteenth century. The story of the discovery is full of interest, and not merely from the commercial standpoint. It is the story of a scientific idea, originated many years ago, taking root in the minds of geologists, developed into theory, and ultimately verified by facts. It is a striking instance of the scientific imagination in advance of the facts, starting from the basis of past experience. The idea has been the centre around which the facts have clustered until, from our point of view of to-day, it appears as a strict induction without trace of *a priori* reasoning.

The Theory of Godwin-Austen.—The physical identity of the coalfields of Somerset on the west with those of Northern France and Belgium on the east was fully recognised by Buckland and Conybeare as far back as 1826. It was not, however, until 1856, that the idea of the existence of buried coalfields in South-Eastern England was advanced by Godwin-Austen, in a memorable paper* read before the Geological Society of London.

He pointed out that the coal seams are vegetable accumulations on flat alluvial marshes close to the water line, and extending over an enormous area, somewhat like that

* "On the Possible Extension of the Coal Measures beneath the South Eastern part of England."

in the lower courses of the Missisippi or the Ganges. The rocks which now cover the seams of coal, and contribute to build up a thickness of from 8,000 to 10,000 feet of coal measures, are merely sand banks and mud banks, accumulated during a period of depression, like that by which the submarine forests on our shores are covered by similar accumulations. At the close of the carboniferous age, these coal-bearing alluvia were thrown into a series of folds by earth movements, traceable at this time all the world over. The upper folds (anticlines) have for the most part been destroyed by rain, rivers, frost, and other sub-aerial agents, as well as by the dash of the waves on the shore line, while the lower folds (synclines) have been preserved by their position below the surface from the operation of the above-named destructive agents. These constitute coalfields more or less isolated from one another by areas of pre-carboniferous rock, exposed by denudation. Great lines of smashing and dislocation were also developed at the same time, and in the interval between the formation of the coal measures and the strata which overlie them, the destruction of the upper curves of the folded rocks has been effected. He next proceeded to show that these folds, running east and west, were the cause of the general direction of the exposed coalfields in South Wales and Somerset on the west, and of the Belgian and north French coalfields on the east, parallel to a great line of disturbance, which he termed the "axis of Artois," which he traced from the South of Ireland, through South Wales and North Somerset, into Westphalia. To the north of this the exposed coalfields lie in long, more or less narrow, east and west, troughs.

Before the deposition of the newer strata, the faulted and folded carboniferous and pre-carboniferous rocks, constituting the axis of Artois, formed a barrier which gradually sank beneath the sea of the Triassic, Liassic, Oolitic, and Cretaceous ages. Against this ridge the newer rocks gradually thinned off until in France the chalk rests on the coalfield over a wide area without intervening strata. This ridge or barrier also, where it is concealed by the newer rocks, is marked by the arch-like fold of the chalk of Wiltshire, and by the line of the north downs in Surrey and Kent. Godwin-Austen finally concluded, from all these observations, that there are coalfields beneath the Oolitic and Cretaceous rocks in the South of England, and that they are near enough to the surface, along the line of the ridge, to be workable. These original views gradually became part of the general body of geological theory. They were, however, not accepted by Sir Roderick Murchison, the then head of the Geological Survey, who maintained, to the last, that there were no valuable coalfields in South-Eastern England.

The Report of the Coal Commission, 1866-71.

The next stage in the development of the question is marked by the Coal Commission of 1866-71, before whom Godwin-Austen gave evidence. Prestwich was one of the Commissioners, and to him we owe an elaborate report, in which he fortified the views of Godwin-Austen by a large series of observations, and finally concluded that valuable coalfields, like those of Somerset, and of North France, and of Belgium, do exist beneath the newer rocks of the South of England, and that the same coal measures, which disappear in the west under the newer rocks of Somerset, reappear in the east, on the Continent, from underneath the same rocks, to the north of the ridge or axis of Artois. He considered them a chain of long, narrow, and isolated, coal troughs, with their position so concealed beneath the newer rocks that it can only be ascertained by experiment. The report materially helped to bring Godwin-Austen's theory to the test of experiment.

The Experimental Stage.

The Boring at Netherfield.—This report was published in 1871. In the following year the Sub-Wealden Exploration Committee was organised by the late Mr. Henry Willett, to ascertain the strata below the Weald of Sussex by an experimental boring. The site, chosen by the writer, was Netherfield, about three miles south of Battle, where the lowest rocks of the Purbeck Wealden formation constitute the bottom of the valley. The work was carried on under considerable difficulties, and it had to be abandoned in 1875. The rocks penetrated were as follows:—

Section at Netherfield.

	Feet.
Purbeck strata	200
Portland strata	57
Kimmeridge clay	1,073
Corallian beds	3'5
Oxford clay	60
	1,905

coalfield lies buried under the newer rocks in South-Eastern England, Godwin-Austen's theory, advanced in 1856, has resulted in adding a new coalfield to the mineral wealth of Great Britain. The question has been finally settled from the geological point of view. It is now being dealt with from the industrial side, by the sinking of shafts by the Kent Collieries Corporation.

The newer rocks covering the coal-measures traversed in the two shafts sunk near the borehole, according to Etheridge, are nearly eleven hundred feet thick as shown below.

Secondary Rocks concerning the Coal Measures in the Dover Shafts.

	Depth Below O.D. ft	in		Thickness ft	in.
Chalk slip	—		..	40	0*
Beach	—		..	18	11
Grey chalk and chloritic marl	113	9	..	106	10
Gault	250	9	..	136	9
Lower greensand..	373	8	..	123	8
Purbeck-Wealden beds ..	460	6	..	86	10
Oolites	1,060	6	..	600	0
Lias	1,097	6	.	37	0

The Extension of the Coal Measures north of Dover.—In 1897 borings were begun by various companies in other areas to test the range of the South-Eastern coalfield. In that year the Kent Collieries Corporation began to sink shafts at Shakespeare Cliff, and to put down boreholes at Brabourne and Pluckley, near Ashford. The Mid-Kent Coal Syndicate also put down a boring at Penshurst, and the Kent Coal Exploration Company began work in various districts under my supervision, with the important result that the coalfield was proved some eight miles away from Dover, at Ropersole (Figs. 1, 2, 3B), close to the high road to Canterbury.

This boring was carried out in 1897-9, with the assistance of Mr. James Newton, engineer in charge. It began at 400 ft. above O.D., at a spot where a thin layer of clay with flints formed the surface. It penetrated the following strata —

	Depth ft.	in		Thickness ft	in
Chalk and chloritic marl ..	834	0	..	834	0
Gault	953	0	..	119	0
Lower greensand	1,025	0	..	72	0
Oolites	1,553	0	..	473	0
Lias	1,580	9	.	27	9
Coal measures with coal seams	2,129	0	..	548	3

* The figures in the Table down to the Lower Greensand are taken from the Simpson shaft, and those below are taken from the Brady shaft. Etheridge's Section, Royal Commission on "Coal Supplies," Part IX, Appendix 5.

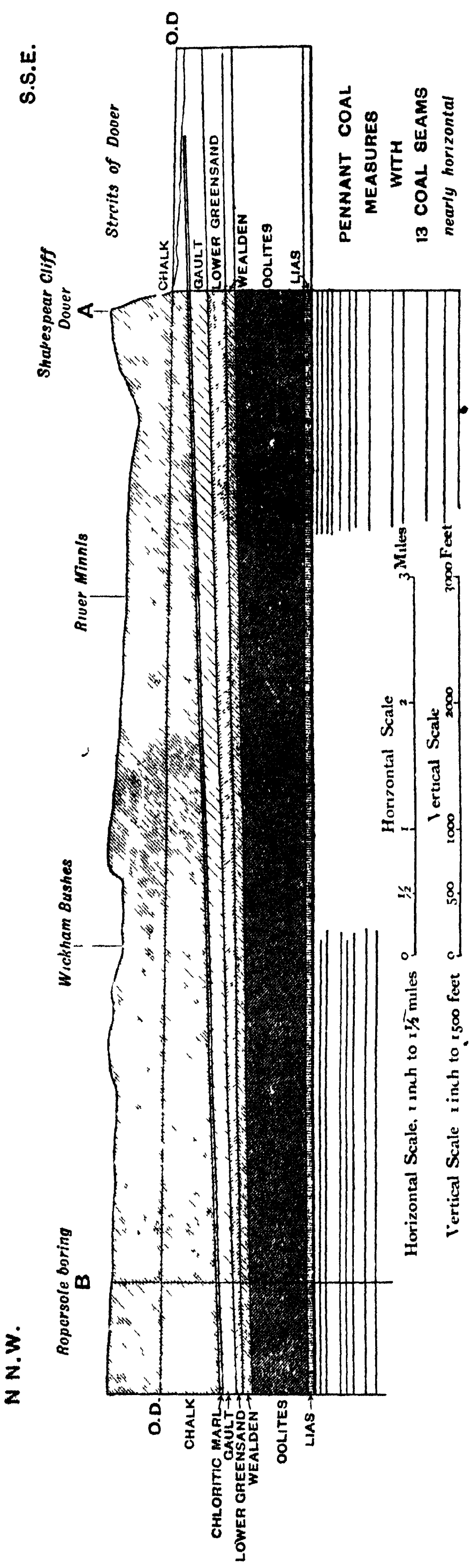

FIG. 2.—SECTION SHOWING PROBABLE ARRANGEMENT OF STRATA BETWEEN DOVER AND ROPERSOLE.

The coal-measures were struck at 1,180 ft. below O.D., and are practically horizontal. They contain thin seams of bright blazing coal, the two thickest being respectively 13 in. at 1,492 ft. below O.D., and 15 in. at 1,665 ft. below O.D. In my opinion they belong to the same series as those at Dover, characterised by the predominance of Sandstones. The approximate horizontality of the strata may be accounted for by the view that they lie in both places in the trough of a fold or syncline ranging from Dover to Ropersole, and beyond along the line of section (Fig 2). This conclusion is much more probable than the view that they extend horizontally over a very large area. It is also strengthened by further evidence from borings, as we shall see, to the south-west and north-east of a line joining the Dover and Ropersole borings.

The Boring at Ellinge.—The Ropersole boring proves the range of the south-eastern coalfield for more than eight miles north of Dover. The field is extended to the west by a further boring at Ellinge, carried out by the Dover Coal Extension Company in 1901-2, under the supervision of M. Breton. The coal-measures were struck at 1,686 ft. 4 in. from the surface, or 1,286 feet below O.D. They were, however, only penetrated to a depth of 129 ft. 4 in. without meeting seams of coal.

Section at Ellinge.

	Depth. ft.	in.	Thickness. ft.	in.
Chalk and chloritic marl	574	2	574	2
Gault	758	6	184	4
Lower greensand	797	3	38	9
Purbeck-Wealden	927	2	109	11
Oolites	1,632	3	705	1
Lias	1,686	4	54	1
Coal measures	1,815	8	129	4

The coal-measures consisted of Sandstones and Shales, approximately horizontal, and probably, like those at Dover and Ropersole, are near the bottom of the synclinal fold of the strata.

The Western Limit of the Coalfield indicated by the Boring at Brabourne.

It remains now to be seen how far the range of the south-eastern coalfield has been proved by other borings. None of the three begun in 1898 by the Kent Coal Exploration Company at Ottinge, Hothfield, and Old Soar, to the north of Tonbridge, have been carried deep enough to give any evidence. We are, however, indebted to Mr. Etheridge for conclusive proof that the south-western boundary does not extend as far to the south-west as Brabourne. There, in a boring made by the Kent Coal Collieries Corporation, a fine-grained, grey, Argillaceous Sandstone, in my opinion Devonian, or Old Red Sandstone, was struck at a depth of 1,921 ft, 5 in. from the surface, the strata being inclined at an angle of 60°, and being covered by a Red Dolomitic conglomerate, of Triassic age, just as in the central axes of the Mendip Hills, to the south of Banwell, and elsewhere.

Section of Boring at Brabourne.

	Depth. ft.	in.	Thickness. ft.	in.
Gault*	72	6	68	10
Lower greensand	303	6	231	6
Purbeck-Wealden	706	8	403	2
Oolites	1,701	8	995	0
Lias	1,873	5	161	9
Triassic conglomerate	1,921	5	48	0
Devonian or old red sandstone	2,004	0	82	7

The high dip of the Devonian or Old Red Sandstone rocks, underlying the Dolomitic conglomerate which has been deposited on its denuded edges, is a most important indication that the trough of coal-measures is to be found at a sufficient distance to the north-east of Brabourne to allow of the coming in of the carboniferous limestone and the millstone grits, which in Somerset and in Northern France underly the coal basin, somewhat as I have shown in the section. (Fig. 3 D.)

This boring has verified the exact position of the Pembroke-Mendip anticline, mapped in 1894,† that defines the southern range of the South Welsh and Somerset coalfields, as well as those of Northern France. In Somerset it emerges from beneath the Triassic, Liassic, and Oolitic rocks, and in Northern France it runs along the line from Marquise, past Ferques, to Fléchinelles and Douai, and beyond. In the district under consideration it runs from the north-west to the south-east, from Wye, at the foot of the Chalk Downs, to Folkestone, and passes under the straits to the south of Cape Gris Nez.

The south-eastern coalfield has its western boundary parallel to this line, at a sufficient distance to allow the carboniferous,

* Report of Mr Etheridge to the Kent Collieries Corporation, 23rd Jan., 1899.

† Dawkins' "On the Probable Range of the Coal Measures in Southern England"—Trans. Fed. Inst. Mining Engineers, vi. p. 17.

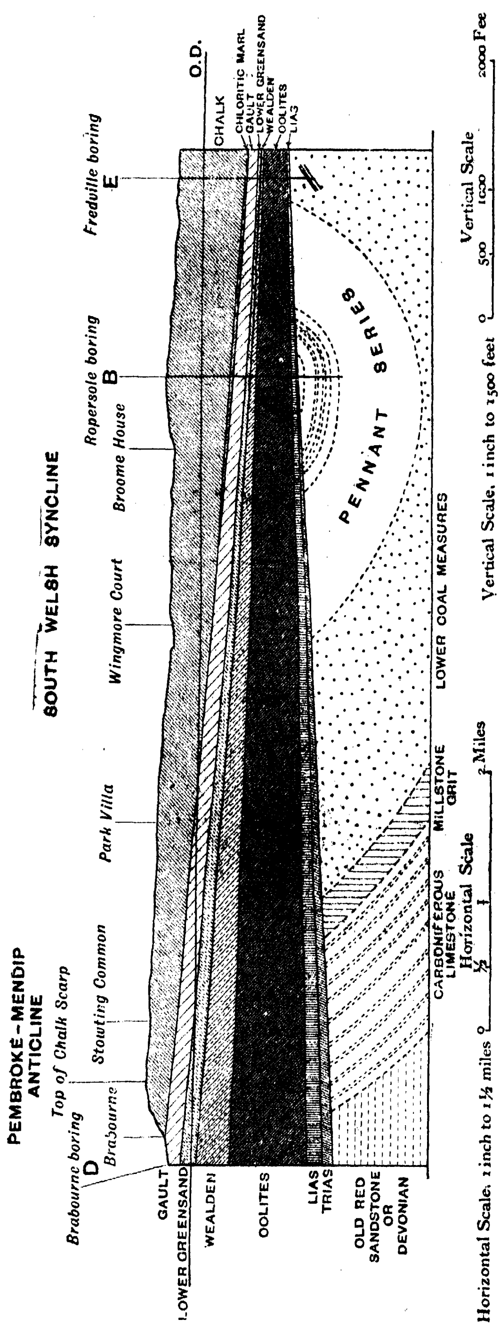

FIG. 3.—SECTION SHOWING PROBABLE ARRANGEMENT OF STRATA BETWEEN BRABOURNE, ROPERSOLE, AND FREDVILLE.

limestone, and millstone grit to intervene, with a high dip like that at Brabourne, as shown in Fig. 3, taken from Brabourne (D), to Ropersole (B), and Fredville (E).

If the relation of this section to that of Fig. 2 be noted on the map (Fig. 1), it will be seen that the sections are approximately at right angles, the one being taken along the dip, while the other runs along the strike of the coal measures. Their south-western boundary can, however, only be accurately marked by further borings, such as that at Ottinge, which I had to relinguish in 1899 in the Oolites at a depth of 842 feet, owing to the liquidation of the Kent Coal Exploration Company. It is approximately represented by the dotted line on the map (Fig. 1), running from the chalk cliffs north of Eastwear Bay, Folkestone, through Lyminge, and crossing the river Stour about half-way between Wye and Godmersham. From this line the south-eastern coalfield ranges eastwards, past Dover and Ropersole, over a very large distict in Kent, its northern marked approximately by the lined area on the map, Fig 1., and eastern boundaries being as yet unproved. It passes under the channel in the direction of Calais, where the coal-measures were struck in a deep boring in 1850.

The Further Extension of the South Coalfield.—These discoveries were laid before the Commission on Coal Supplies in 1903, and caused further experiments to be undertaken by the Kent Coal Concessions Company, organised by the energy of Mr. Arther Burr, and acting under my advice. In the borings described above, it had been proved that the strata between the Gault and the coal-measures thinned off, with great rapidity, to the north and east, as Godwin-Austen said they would thin off. Consequently my attention was directed to the northern and eastern borders of the proved portion of the coalfield. Sites for boring were selected, and the further explorations began in 1904, and are now being carried on, with the result that the only two borings which are as yet deep enough to strike the coal-measures, have resulted in the discovery of valuable seams of coal.

The Boring at Waldershare.—The first to be considered is that at Waldershare, about three miles due east of Ropersole (Fig. 1, E.) It began in the chalk, at 325 feet above O.D., and has now reached the depth of about 2,270 feet, or 1,955 feet below O.D. The section is as follows:—

Waldershare Boring.

	Depth. ft.	in.	Thickness. ft.	in.
Chalk and chloritic marl ..	820	0	820	0
Gault	976	0	156	0
Lower greensand	1,046	0	70	0
Purbeck-Wealden	1,088	0	42	0
Oolites	1,389	0	301	0

* For details as to the coal-measure shales, I am indebted to the late Sir Joseph Prestwich.

	Depth. ft.	in.		Thickness. ft.	in.
Lias	1,394	0	.	5	0
Coal-measures.—Thick coarse sandstones, with numerous pebbles of coal, sometimes forming a coal conglomerate, with subordinate layers of bind shale and underclays and occasional nodules of clay ironstone ..	1,743	0	..	349	0
Binds (claystones), shales, and underclays, with one thin layer of sandstone	1,816	11	..	73	11
First coal, blazing	1,818	7	..	1	8
Fire clay	1,825	3	..	6	8
Bind	1,878	0	..	52	9
Second coal, blazing	1,881	4	..	3	4
Fire clay	1,887	2	..	5	10
Bind	1,604	3	..	16	1
Third coal, blazing	1,908	9	..	4	6
Fire clay	1,911	0	..	2	3
Bind	1,955	4	..	44	4
Fourth coal, according to boring returns	1,956	8	..	1	4
Fine clay passing into bind.	1,961	10	..	5	2
Fine grey sandstones and binds in equal proportions ..	2,244	1	..	282	3

The boring is still going on.

The four coal seams and associated fire clays form a group of workable beds, the coals presenting a total thickness of 10 ft. 10 in.

By this discovery the range of the coalfield is extended about three miles to the east of Ropersole.

The Boring of Fredville.—The last boring to be considered is near Fredville-park, close to the railway, and about three miles to the north-west of Waldershare, and a little under two miles to the north-east of Ropersole. It was carried on in 1905-7, and presents the following section:—

Section of Fredville Boring.

	Depth. ft.	in.		Thickness. ft.	in.
Chalk and chloritic marl ..	860	0	..	860	0
Gault	948	0	..	148	0
Lower greensand	990	0	..	51	0
Purbeck-Wealden	1,035	0	..	36	0
Oolites	1,358	0	..	323	0
Lias	1,368	6	..	10	6
Coal-measures	—		..	—	
Shales and binds with one ten feet bed of sandstone ..	1,402	0	..	37	6
Bind	1,423	0	..	21	0
First coal, hard but blazing ..	1,424	6	..	1	6
Fire clay	1,427	6	..	3	0
Shale and bind	1,445	3	..	17	9
Second coal, hard, blazing ..	1,446	9	..	1	6
Fire clay	1,447	3	..	0	6
Shale	1,448	9	..	1	6
Bind	1,458	0	..	9	2
Grey sandy bind with subordinate layers of sandstone	1,499	0	..	41	0
Grey bind	1,501	5	..	2	5
Dark shale	1,501	6	..	0	1
Third seam, bituminous ..	1,510	10	..	4	4

The coal-measures up to the present time have only been penetrated to about 106 feet, and the boring is to be carried on to a depth of 2,500 feet from the surface, so as to ascertain the coal seams in a thickness of 1,000 feet of coal-measures. The three seams already proved are two of 1 ft. 6 in. and one of 4 ft. 4 in. all hard, bright-blazing coals. The dip of the beds is 17°.

The Sub-divisions of the South-Eastern Field.—We must now discuss the very difficult question as to whether the groups of seams in these four borings can be referred to distinct horizons. In my report to the Commission on Coal Supplies, I stated that the seams at Dover and Ropersole probably belong to the same series, although the several seams could not be identified, and that judged by the plants they belonged to the upper group. This conclusion has since been confirmed by the study of the physical character of the coal-measures in the coalfields of Bristol and South Wales, and more especially of the singular conglomerates, formed of coal pebbles, first noted by Logan and De la Beche. The thick coarse grey sandstones both of Dover and Ropersole are identical with those of the Pennant grit series, in which the coal seams are few in the south-western coalfields. The section at Waldershare probably shows the base of the Pennant sandstones, resting on the Lower Shales and Binds, the equivalents of the above south-western coalfields, so rich in coals. It is identical with the section in the Bristol coalfield given by Mr. Anstie, near Bitton. The coal-measures at Fredville also, in my opinion, belong to the same series. Whether the coals are the equivalent of those struck at Waldershare, or belong to a lower horizon in the Lower Shale Series, remains to be proved by the results of deeper boring.

As the evidence stands at present the seams proved in the south-eastern field are:—

	Seams.		Thick. ft.	ins.
Dover, in Pennant grit	13	..	22	6
Ropersole ,, ,, ... (thin)	12	..		
Waldershare, in Lower Shale Series ..	4	..	10	3
Fredville* ,, ,, ,, ,, ..	3	..	7	0

* These are figures corrected for the dip of the strata.

They occur in two, or perhaps three groups, and those in the Lower Shale Series are the most important.

The Structure of this portion of the Coal-field.—The dip of the strata throws light as to the structure of this portion of the coalfield. The high dip at Waldershare, on the east, of 30°, sinks to zero at Ropersole, a fact that can easily be explained on the hypothesis that it is the corresponding fold on the east to that so strongly marked at Brabourne on the west, as shown in the section, Fig. 3. The lower coal-measures would under these conditions crop out on the north-eastern side of the basin, in the two places where they have been looked for. In other words, the north-eastern side of the trough of coal-measures has been proved in this direction, although the exact margin has not been fixed. It has, however, been pushed two miles further to the north-east (see map, Fig. 1). The trough passes from Dover to the north-east, making for Canterbury, and is one of the series so valuable in Northern France and Belgium.

It is further to be noted that the average dip of the Lower Shale seams at Waldershare is 20°, or 10° less than that of the Pennant series above. At Fredville it is 17°. This may indicate an unconformity between the two groups of strata.

The South-Eastern Field Available.—I turn now to the question as to the availability of the coalfield. The denuded surface of the coal-measures occurs at Dover at 1,100 feet below O.D., at Ellinge at 1,206, at Ropersole at 1,100 feet, at Waldershare at 1,069, and Fredville at 1,109, is sufficiently near the surface to be worked. Coals are now being obtained from depths in Britain, amounting to nearly 4,000 feet. In Kent they are well within the above limit of depth laid down by the two last Royal Commissions on British Coalfields. The lined area in the map Fig 1, represents the approximate region in which the coal seams struck in the borings may be expected to occur in East Kent.

It will undoubtedly be extended over the adjacent districts by the borings now being made under my direction, by the Kent Coal Concessions Company, and by other similar enterprises. It will probably turn out to be a large, narrow trough, as in North France and Belgium, one of a series extending north-westwards from Dover under the newer rocks, linking the above coalfields with those of Somerset, to the north of the Pembroke-Mendip anticline, which represents in a restricted sense Godwin-Austen's axis. It is probably not less than 8,000 feet thick. It is proved by the few borings which have only penetrated it it for a short distance, to be of great value. It will probably rank, when fully developed, among the important coalfields, and cause centres of industries to be established in Kent, like those of Liège and Valenciennes. It will probably attract a large population to the lonely downs, that will by their labours add to the wealth of the nation, and at the same time convert the white into the "black country," or at all events into "studies in black and white."

Conclusion.

In the preceding pages we have traced the gradual verification of Godwin-Austen's theory by a series of experiments carried on during the last thirty years. It has ultimately added a new coalfield to the national assets. It is a striking instance of the value of scientific research to the nation.

DISCUSSION.

The Chairman, in opening the discussion, thought the author had put before the audience the hunt after coal on the south-eastern coalfield in a most fascinating manner. He remembered some years ago, in the course of one of the annual duels between Sir Edward Watkin and Mr. James Staats Forbes, Sir Edward being a firm believer in the existence of coal at Dover, and the Chatham Company being a little sceptical on the matter, that one of the audience at the meeting of the Railway Company who asked "what about coal?" received the reply, "I am told that coal has been found in the neighbourhood of Dover, and, if that is true, then we shall see what we shall see." He thought the author would agree with him that it was still necessary to use the same cautious phraseology. The Professor had undoubtedly brought certainty very much nearer than it was in those times, and, as he showed, depth was now no serious difficulty in mining. Personally he had had a good deal to do with another metal, and in all probability, if it had been steam coal instead of gold, it would have been quite as valuable, but there would not have been such a fuss made about it. The width and the value of the coal were the important points to be considered. If the widths of which the author spoke were of such a character as those who understood coal mining believed to be payable, he had very little doubt that, sooner or later, money would be forthcoming to make a thorough practical experiment of what the coal measures were capable of producing. In fact it might be said that a really practical experiment was already being made, because shafts were being put down at Waldershare and Fredville which, he believed, were of a size capable of being used for

hoists. With regard to the Professor's remarks on the question of the development of coalfields spoiling the beauties of the scenery, a good many of his friends had said to him that it would be a pity for Kent, the garden of England, to be spoiled by chimneys and smoke. If those people only knew the struggle that a good many landlords had gone through during the last twenty years to hang on to their estates by their eyelids, and at the same time do their duty by them, he did not think they would look at the matter quite in that light. If, as the Professor said, the coalfields would be a commercial advantage to England, he thought they would manage to put up with the scenery being occasionally interrupted by chimneys. A great friend of his, Lord Darnley, had a beautiful estate in the neighbourhood of Strood, and within a few miles of his park 30 or 40 chimneys could be counted giving forth large masses of smoke through the greater part of the day, but he had not observed that the neighbouring country or park had been in any way spoiled. He was sure that if eventually capitalists were willing to pnt up chimneys further east in Kent, the inhabitants of the county would put up with that inconvenience. That, perhaps, was rather a far cry yet, but he hoped in two or three years time, if the author was willing to give another paper upon the subject, he would be able to confirm his prophecies and conjectures by a very practical description of what capitalists believed the coalfields could produce. He was sure all present would agree that the hunt after coal described by the Professor had been of a most fascinating description, based upon a conjecture which only had for its proof geological surmises. Now the results of those conjectures and surmises were known, all would agree with the author that science had been amply borne out in the present instance by results, and it would give people greater confidence in trusting in those scientific forecasts which geologists and mining engineers had to make. He had a good deal to do with mining engineers and geologists, and he knew they were most cautious in using any expression which gave a distinct idea as to value; but Professor Boyd Dawkins had deliberately stated that the coal measures in Kent were valuable. When a man of the author's distinction and reputation deliberately used an expression of the kind, it was pretty certain that sooner or later--he hoped sooner—it would be found that the expression was justified.

Mr. W. WHITAKER, F.R.S., pointed out that, curiously enough, the two borings which were of the greatest interest were those which had not given economical results, viz., those at Brabourne and near Battle. Of all the Kentish borings, the one at Brabourne was the most interesting as proving a distinct negative, and that the edge of the rocks had been reached which underlaid the coal in other parts. It was interesting to notice that, where coal measures were touched, their depth did not vary very much. In some cases it did apparently, but it must be remembered that some of the borings started on high ground compared with the lower ground at Dover. If the levels were all reduced to Ordnance datum, it would be found that the depth of the coal measures came in all cases within a few hundred feet. The same feature had been found in the borings which had been made near London. At a depth of something like 1,100 feet below sea level, old rock was found, and in London most of it presumably was older than carboniferous. The borings under London for coal had not been thrown away, because they pointed to the fact that, at present, it was impossible to get coal under London, so that the beauty of London would not be spoiled! He did not think much of the smoke bogey which had been raised in connection with coalfields, because collieries were not worked on the principle of erecting as many chimneys and making as much smoke as possible. Kent had suffered more from its cement works than it was likely to do from collieries. When looking at some Kent cement works many years ago, he remembered counting a number of chimneys, which were all emitting a nasty, white acrid smoke, much worse than the smoke produced from the combustion of coal. Modern collieries also used underground electric haulage, and that system would probably be used in the Kent collieries when they were fully developed. Undoubtedly, however, there would be a certain amount of smoke and destruction of scenery; but it was pleasant to reflect that the descendants of the people who were living at the present day would find, when the coalfields were worked out, that the country had reverted to its natural beauty. Nature had an uncommonly good way of beautifying refuse heaps and spoil banks. He had walked over ground where collieries had existed many years ago, and he should never have guessed it; everything had gone back to the green and ordinary look of the country. It was necessary in considering the question to take a view a little outside the mere garden view. Kent might be the garden of England, but this country did not exist for purely gardening purposes. If a coalfield could be worked at a profit over a large area of Eastern Kent, was it reasonable to expect people to think of the mere beauties of scenery compared with the wealth, strength, and power it would give to England at large? It was by its coalfields that England was powerful, and the addition of a coalfield to this country was distinctly a patriotic work.

Mr. GEORGE HOLLINGWORTH thought that, from the point of view of the depth at which coal had been discovered, there was nothing to prevent the establishment of collieries in Kent, while several of the seams which had been proved were of a workable thickness or width. The question of thickness resolved itself into the question of the price obtained for the coal. A

particular seam might be considered as thin, compared with seams in a large coal district where the seams were thick and the price was in consequence low; but the same thickness of seam in a place where coal was high became workable. One point which had not been much touched upon in the paper was the character of the cover of secondary rocks as bearing upon their availability. So far as he understood the question of the difficulties of sinking through the upper rocks in Kent, they were very much less than in many places in this country. The probability was that there would not be any very great quantity of water to contend with, which was one of the most serious difficulties in coal-mining. He knew of collieries where as much as six million gallons of water per day had to be dealt with, but that quantity was not likely to be in any way approached in Kent. The Chairman had stated that sinkings were in progress of sufficient size to deal with large outputs. The sinkings were only in the early stage of construction, the deepest at present being a little over 400 ft., while the nearest seam to the surface was about 1,500 ft. He anticipated that, in the course of a year or two, more than one pit would have been sunk down to the coal measures, and this would dispose of any question there might be as to whether the Kent coalfields were commercially workable or not. In his opinion that was already a a foregone conclusion, but it would be possible to demonstrate it by actual fact before long.

Mr. D. A. LOUIS thought it might be of interest if he stated that he had recently visited the Kent coalfields, and inspected the cores, and he had been particularly struck with their similarity at different parts of the field. In one place a boring of 1½ ft. diameter was being made, while at another the boring was of a very considerable magnitude, namely, 21 in., and the man in charge of the work went down the hole to show him that it was of a really workable size. Two syndicates, which had very considerable confidence in the predictions of the author, were undertaking the work, one of them conducting the borings and the other the sinkings, and very serious work was being done, all the timber being ready for the erection of a considerable head, and foundations were being put in for big engines. He should like to ask the author how the dips were ascertained.

Captain ARTHUR H. LIMPUS, R.N., stated that he recently read in one of the mining journals a paper by Professor Lapworth, who described how he was apparently learning to define the boundaries of the great Midland coalfield, which he referred to as underlying the red Triassic rock, and he also referred to the various thicknesses of the covering rock. He would like to ask Professor Boyd Dawkins whether the same layer of Triassic rock and the same coal measures were found in the midland and northern coalfields as in the south. It would also be of interest to know whether steam coal was found in the same boring as ordinary house coal or cannel coal.

Professor BOYD DAWKINS, in reply, stated that he ascertained the dips in the only possible way open to him, namely, by taking the measurements of the dips in all the cores that he could obtain and averaging them. In that way he worked out the very curious fact that, in the Pennant series, the dips were higher than in the lower shales, which occurred at Waldershare below the Pennant series. He did not know that there was any other way of ascertaining the dips. He knew it was not possible, on such a small horizontal space as was offered by a core, to get absolute accuracy, but he did his best and averaged a very large number, and he did not know how he could have formed any idea of the dips in any other way. Professor Lapworth, in his excellent account of the Midland coalfield, dealt with the thick deposit of red rock which overlay it. Godwin-Austen had pointed out that, in all probability, there would be no Trias in the south-easterly regions of Kent and Sussex. The only trace obtained of it was at Brabourne, which was outside the coalfield, and there Triassic rocks, which were the pebble beaches belonging to the great sand banks which, in the Midland and North of England formed the red sandstone which overlies the coal measures, were obtained. With regard to the question of whether steam coal was found in the same mine as house coal, it was a fact that, in some instances in South Wales and in the Forest of Dean, a seam of coal started by being of the ordinary bright blazing character; then it would lose its bituminous or volatile element and be converted into steam coal, with a higher percentage of carbon; and then the last stage in the change of the physical character of the coal was found in the steam coal being replaced again by anthracite. So far as he knew, no anthracite had been found in the Somerset fields, and he was not sure whether any steam coal, as obtained in South Wales and as used for naval purposes, had been found there. A good deal of confusion existed with regard to the designation of steam coal. The steam coal of Midland and Northern England was different from the best steam qualities of South Wales coal. He used the term steam coal as referring to coal of higher qualities, with a greater percentage of carbon, as found in South Wales. He did not know that any such coal had been found in Somersetshire, and he did not at all anticipate that any of this higher class of steam coals would be found in the Kent area, for the very simple reason that they were not found on the Continent, in Northern France, Belgium, or in Germany.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Professor Boyd Dawkins, for his exceedingly interesting paper, and the meeting terminated.

NOTES ON INDIAN RAILWAY SYSTEMS.*

I.

The East Indian Railway.—In examining a few typical systems, the East Indian Railway claims early attention, as second in point of aggregate mileage, and second in age—for a section of the line, 38 miles in length, was opened for traffic in 1854. The East Indian Railway proper has a length of 1,932.87 miles, and with its three subsidiary systems has an aggregate length of 2,196.22 miles of 5 ft. 6 in. gauge. The construction of the main line, from Calcutta to Delhi, was completed in 1867. Double-headed steel rails weighing 75 lbs. per yard, and bull-headed steel rails weighing 85 lbs. per yard are used on the main line, but instructions have been issued that the heavier rails are to be used on all main-line renewals. For sleepers, cast iron, various Indian woods, and Australian hard woods have been miscellaneously employed. Cast-iron plate sleepers are to be used with all new 85 lbs. rails. Stone ballast is used throughout. No specially difficult features were encountered in the construction of this line, the gradients being easy, the ruling gradient on the main line being 1 in 300, with one case of 1 in 200 and one of 1 in 100. The worst gradient on a branch line is 1 in 80. The sharpest curve has a radius of 1,525 feet.

The lines were purchased from the East Indian Guaranteed Railway Company by the State in 1880. The purchase price was £32,750,000 sterling, of which four-fifths was paid in the shape of a terminable annuity, while one-fifth of the annuity was deferred, and holders of this portion, representing a working capital of £6,550,000, constitute the present East Indian Railway. The holders of this stock receive a guaranteed rate of interest of 4 per cent. plus a share of the surplus profits until 1919, when the balance of the annuity will become payable up to termination in 1953.

The rolling stock used on this line included (at the end of 1904) 144 passenger engines and 755 engines used for goods and mixed traffic. The average mileage run per passenger engine is 34,543; the goods engines have a smaller annual mileage of 20,897 miles. Per diem the respective mileages are 94 and 57. The ton-mileage hauled per engine is 8,652,000 miles. The coaching stock amounted to 2,380 vehicles, which covered an average mileage of 142 miles each per day. The goods vehicles numbered 17,382 of all classes, and covered an average distance of 50 miles each per day. The profit per goods-vehicle mile was just over 19 pies (about 1·68 pence).

The Great Indian Peninsular Railway.—The Great Indian Peninsula Railway can boast of having had a section open for traffic in 1853, and possesses a greater mileage than the East Indian Railway. The Great Indian Peninsular Railway proper covers a distance of 156·63 miles of 5 ft. 6 in. gauge, while subsidiary lines, also of broad gauge, cover 1,240·53 miles. There is also the Gwalior Light Railway, 183·53 miles in length, of 2 ft. in gauge. Bull-headed steel rails, weighing 82 and 86 lbs. per yard, have latterly replaced the earlier double-headed iron rails, and similarly cast-iron pot sleepers are replacing the wooden sleepers which were first employed. The type of ballast used varies with the locality—broken stone, gravel, and sand being variously used. The ruling gradients on ordinary sections of the line, vary from 1 in 100 to 1 in 200, except on the Ghat section, where 1 in 37 is to be found. The line was purchased from the Great Indian Peninsular Guaranteed Railway Company by the State in 1900; the purchase price was £40,781,568 payable up to the 17th August, 1948, in the form of a terminable annuity of £1,268,516. Previously the State had guaranteed interest, and in carrying out this guarantee, fairly heavy losses were sustained between 1890 and 1900. These have since been greatly reduced, but have not yet given place to a profit. The rolling stock used comprised, at the end of 1904, 821 locomotives, no differentiation being made between those used for the passenger and for the goods and mixed services. The respective engine mileages for the two classes of service have, however, been computated; passenger engines covering 25,619 miles per annum (or 70 per day), and goods engines 18,692 miles per annum (or 57 per day). The ton mileage hauled per engine per annum was 6,207,000. The passenger vehicles numbered 2,243, and covered an average distance of 130 miles per diem. The goods vehicles of all classes numbered 11,552, and covered an average distance of 38 miles per day. The average profit per goods-vehicle miles was 20·8 pies (about 1·73 pence).

The Eastern Bengal State Railway.—The association of this State-operated broad gauge system and the Government began at an early date in 1868, when the State acquired the section between Calcutta and Port Canning. Further acquisitions took place in 1884 and 1887, when a number of broad gauge lines were acquired and merged into the Eastern Bengal System. At that time the mileage of 5 ft. 6 in. track open for traffic was 235 miles, a length increased to 279 miles in 1904, while 106 miles are either under construction or sanctioned. This system also comprises 638 miles of metre gauge track, the construction of which was commenced in 1874, and two short lengths of 2 ft. 6 in. gauge, covering some 67 miles. Other short lengths of 2 ft. 6 in. gauge have been converted into metre gauge lines.

The permanent way on part of the broad gauge lines is now being relaid with 85 lb. bull-headed steel rails in place of 73 lb. and 75 lb. double-headed steel rails. For sleepers, cast-iron and sal wood are used, being laid on brick ballast, except where stone ballast is being used in relaying the track with 85 lb. rails.

On the metre gauge sections, flat-footed steel rails weighing 50 and 41¼ lbs. per yard, laid on sal

* Abstracted from the Indian Government Railway Returns.

sleepers, are employed. Brick ballast is being replaced with stone and shingle. In neither case are the gradients heavy, the ruling broad gauge gradient being 1 in 300, and the ruling narrow gauge gradient, 1 in 200. Financially regarded the system as a whole has been exceedingly profitable, substantial gains having accrued to the State during the past 16 years. Contrasting the gross earnings per mile per week on the three gauges during the past three years, the following striking figures are obtained :—

	1902.	1903.	1904.
	Rupees per week.		
Broad gauge	728	707	751
Metre gauge (excluding Dacca section)	235	239	233
Narrow (2 ft. 6 in. gauge)	66	72	82

The relation of working expenses to gross earnings during these three years has been increased 48·18 to 53·14 per cent. on the broad gauge, from 48·65 to 55·69 per cent. on the metre gauge, and has been reduced from 78·03 to the more commercial ratio of 60·86 on the narrow gauge.

The locomotive rolling-stock used on the 5 ft. 6 in. gauge, consisted of 59 passenger and 88 goods and mixed traffic engines. The annual passenger engine mileage was 22,212 (or 61 miles per diem), and the annual goods engine mileage was 21,380 (or 59 miles per diem). The ton-mileage hauled per engine per annum was 5,141,000 tons. The passenger vehicles numbered 589 and covered 79 miles per day. The goods vehicles of all classes amounted to 3,340, the average mileage per vehicle per day being 25 miles. The average profit per goods-vehicle mile during 1904 was 17·28 pies (or 1·44 pence).

The North Western (State) Railway System.—The extensive system which has a length of nearly 4,000 miles, is almost entirely laid on the 5 ft. 5 in. gauge. The actual length of broad gauge line open for traffic is 3,812-59 miles. There are no branches or sections of metre gauge, but some feeder lines of 2 ft. 6 in. (95·98 miles) and of 2 ft. ·02 in. (6·18 miles) are in use. One particular feature of the system is its extreme length. For 23 years there has been a continuous chain of railway communication on this system from Calcutta to Peshawur, a distance of 1,555 miles. As one Imperial system, the North Western has only existed under that name since 1886, when a large number of separate systems were amalgamated under one name and one control.

Of the engineering features of the line, it can only be said that the permanent way is of various types, and that the curator of a museum of rails would find an interesting variety of specimens of iron and steel rails, flat-footed, double-headed, bull-headed, the weights also varying between 60 and 100 lbs. per yard. For sleepers, wood, cast-iron pots, and steel transverse sleepers are all used.

The reasons for the construction of one section may be mentioned before passing on to a consideration of revenue or equipment. On the right bank of the Indus a chord was constructed between Kotri and Rohri (about 190 miles in length) on account of the set of the River Indus, which rendered the line along the right bank dangerous. Frequent breaches caused communication with Karachi to be intermittent, dislocating the export trade, and cutting off communication with the North-West Frontier Province. The present line, constructed on the left branch of the river, is on high ground, and less liable to inundation. It saves 36½ miles on the through distance from the Punjab to Karachi, and also gives an alternative route to Quetta.

On the financial side, 1904 proved to be a record year. The nett earnings amounted 5·92 per cent. on the capital outlay, the nett gain to the State was £464,520 sterling; the expenditure was 47·60 per cent. of the earning; while the revenue per line of mile per week was 361 rupees.

The locomotive equipment comprises 719 engines, no differentiation being made between passenger and other locomotives. The average mile per locomotive (of all classes) per day is 27,124; and the annual ton mileage hauled per locomotive is 8,373,000 tons. The passenger rolling stock amounts to 2,369 vehicles of all types, these covering an annual average mileage of 47,667 miles apiece, and an average daily mileage of 131 miles. The goods vehicles number 11,566, these having an average annual mileage of 63 miles. The average profit per goods-vehicle mile in 1904 was 17·36 pies (or 1·45 pence).

(*To be continued.*)

TRADE WITH TUNIS.

In his report on trade with Tunis (Cd. 3283), Mr. Consul-General Berkeley shows how it is that French trade in cloths is increasing rapidly in Tunis at the expense of British. Fifteen years ago France did but little trade with Tunis in any cotton goods; now, whilst the United Kingdom maintains a considerable superiority in bleached and unbleached cloths, it only just holds it own in printed cloths, and falls behind very considerably in dyed cloths and manufactured articles. It will not be forgotten that British cotton fabrics pay a duty of 5 per cent., while those of French manufacture enter free. This duty does not seem to affect the British trade in unbleached tissues, but it tells on that in bleached and other goods, and this disadvantage is increased by the French practice of direct sales between the manufacturer and the local dealer to the exlusion of the export agent, who seems to be an unavoidable adjunct to British trade in Tunis. The latter has thus not only to contend against the original disadvantage of the 5 per cent. duty, but against a further charge of 7 to 10 per cent., which represents a profit without which the export agent will not risk dealing on credit abroad. Admittedly British cotton fabrics sold in Tunis are superior to the French, especially those intended for native use, but it is a great deal to expect that they should continue to hold their own under a penalty of 12 to 15 per cent.

HOME INDUSTRIES.

Export of Cotton Goods.—The figures relating to the production of raw cotton, and the export trade in cotton goods, afford an interesting comparison between the United Kingdom and the United States. Notwithstanding the efforts of other countries, the United States still supply three-fourths of the raw material used by the outside world in the manufacture of cotton goods, and the United Kingdom is almost as dependent upon the United States to-day for its supply of raw cotton as it was in the sixties, when the American Civil War cut off American supplies. But whilst the United States supply the raw material, it is the United Kingdom which, in special degree, creates and distributes the finished product. *Bradstreet* gives the values of the exports from the two countries during 1905 and 1906:—

	1905. dols.		1906. dols.
Cotton cloths:			
United Kingdom..	344,630,000	..	366,908,200
United States .. .	47,652,434	..	32,282,504
All other goods:			
United Kingdom..	103,117,500	..	117,815,700
United States	8,808,566	..	10,678,544
Total all cotton goods:			
United Kingdom..	447,748,400	..	484,723,900
United States	56,461,000	..	42,961,048

These figures show that the United States do not export one-tenth part of the cotton goods exported by England, and yet the former country grows three parts of the world's supply of cotton, whereas the United Kingdom does not raise a pound of cotton, and has to import its entire supply of raw material. Small as was the American export in 1905, it was much smaller in 1906, whilst the exports of the United Kingdom showed large expansion. The explanation of the decrease in American exports is to be found in the practical cutting in two of the American export trade in cotton cloth with China. Great Britain also shipped less to China in 1906 than in 1905, but then China takes only about 10 per cent. of all British exports, whereas she takes more than half the American exports, so that the effect of the shrinkage upon American trade was much more significant than upon British. There has, of course, been great expansion in the American domestic trade.

The Motor Omnibus.—The publication of accounts and statements of the various omnibus companies catering for the transport of the metropolitan public demonstrates the peculiar conditions under which this industry is being carried on, and the great risks accepted by shareholders in the motor omnibus companies. These companies have practically destroyed the horse omnibus companies as such, they have seriously affected the earnings of "the Tubes"; they are carrying as many passengers as the most sanguine anticipated, and yet there is good reason to believe that, if proper allowances were made for depreciation, not one of them could be shown to be running at a profit. Admittedly most of them are being worked at a loss. In the desire to steal a march upon the horse omnibus companies, they have spent immense sums in putting upon the streets vehicles insufficiently tested, both from the point of view of official requirements, and earning power. In their report the directors of the London Road Car Company, for example, tell their shareholders that early in October last a large number of horse cars were withdrawn, but the directors "extremely regret to have to report that when the motors to replace these horse cars were presented to the police authorities for licensing they were most unexpectedly rejected, on the alleged ground of not being fit for public use." Again, the chairman of the Associated Omnibus Company, told the shareholders in general meeting that motor omnibuses had been placed on the streets without regard to their efficency or suitability. If there had been less haste much money would have been saved. "As it is," he added, "there are some hundreds of motor chassis in London absolutely useless. Some have broken down, others will not work properly, and others the police will not pass as they do not comply with the police regulations." Whilst injuring other forms of transport the motor omnibus is spelling heavy loss to its owners. The pioneer has suffered, as the pioneer always suffers. Of course the present vehicle will be improved. It is too heavy and costly to work. Lightened and cheapened it will leave no place for the horse omnibus, but not a few will suffer heavily in the process.

The Horse Omnibus Reports.—Meantime the half-yearly reports issued by the horse omnibus companies, which until recently controlled the street traffic, show the effect of the competition upon their profits. Glancing at the figures submitted by the oldest and largest of the horse omnibus companies, it is noticeable that it carried more passengers in the second half of 1906 than in the corresponding period of 1905, but its net working profit fell from £19,100 to £1,430. In the second six months of 1905 it carried 108,068,400 passengers, as against 108,655,300 in the corresponding period of 1906, but the gross receipts fell from £618,790 to £613,100, whilst the dividend has fallen from 6 per cent to 5 per cent, and the reserve from £145,000 to £130,000. The depreciation in capital value of the company's stocks has been, as was to be expected, very serious. As was pointed out in these Notes a year ago the directors have been in a most difficult position. They had no wish to "rush" the change from horse to motor traction, but with other companies springing up on all sides to compete for the traffic, and the public determined to have motor carriages, they had to adopt the motor omnibus before they were satisfied that they had found the right type of vehicle.

Steamship Developments.—Important developments in steamship services may be noted. In the Newfoundland House of Assembly a scheme is under

discussion for a weekly service of 17-knot steamers between Killery, on the west coast of Ireland, and Green Bay on the east coast of Newfoundland. This scheme is said to ensure a saving of thirty-two hours over any other Atlantic route, and the Colony is said to be willing to pay an annual subsidy of $75,000. Some time ago the Commonwealth Government made a new contract with an English syndicate to take up the Australasian mail service, and the cost of the new fleet is estimated to be between three and four millions. Financial discussions, however, have delayed the completion of capital arrangements, and the fear has been expressed in Australasia that the service will not be ready to time. Again, at a meeting of shipowners, manufacturers and others, held at Buenos Ayres a few days ago, it was decided to create an Argentine Transatlantic Steamship Company, and a committee has been appointed to put the project into execution. Then the United States have in contemplation a line of 16-knot steamships from United States ports to the Gulf of Mexico and Brazilian ports. These various enterprises, should they, or any of them, be carried out, can hardly fail to bring work to British shipyards.

Mineral Production.—The Home Office has just issued its preliminary returns of the mineral production of the United Kingdom for 1906. These figures show that the production of coal was considerably larger than in 1905, the output being 251,050,809 tons as against 236,111,150 tons in 1905. Ironstone also shows considerable increase as from 7,860,969 tons to 8,209,880 tons, and oil shale from 2,496,567 tons to 2,546,113 tons. Fireclay, too, showed increase from 2,847,122 tons, to 2,971,173 tons; clay and shale other than fireclay and oil shale falling from 306,561 tons to 252,275 tons. The number of persons employed underground increased from 691,112 to 709,545, and above ground from 167,261 to 172,800, a total increase of 23,972 persons, attributable for the most part to the increased production of coal, amounting to 15,000,000 tons more than in 1905; the increase in the exports of coal being 8,433,000 tons, or 17·7 per cent., the increase in the home consumption being 6,817,000 tons, or 3·6 per cent.

The Railway Position.—There would seem to be ground for the belief that 1907 will be a more favourable year for the holders of railway stocks, which are less in favour than they were some years ago. A succession of lean years, from the dividend point of view, has resulted in a serious fall in the prices of these stocks. In the decade 1863-1905 there was an increase of no less than £212,000,000, or 22 per cent. in capital expenditure, whereas the increase in net earnings was only 14 per cent. The return upon new capital is much less immediate and large in the United Kingdom than in new countries such as the United States and Canada. Here the increase in traffic is only about 3 per cent., there 10 per cent., and in Canada more, so that longer time has to elapse in the United Kingdom before new capital outlay becomes productive. But for some time to come there will be little occasion to spend much new capital on English lines. The expenditure of the last ten or twelve years will be bearing fruit in increased degree, and the further increase in capital charges should be comparatively small. Then railway companies have effected considerable economies in working, and further economies may be confidently anticipated. The railways are feeling the improvement in trade. Compared with two years ago there is an improvement of over 5 per cent., and in the eight weeks of the current year there has been a further improvement of nearly £300,000 as compared with the corresponding weeks of last year. It is true that coal and wages are disturbing features in the present position, but the present growth of the demand for coal is evidence of the activity of trade, which must benefit the railways; and if the demands of the men for higher wages are conceded it may be hoped, and even expected that, at any rate in many cases, more and better work will be given in return. On the other hand prices of railway stocks are at an unusually low level.

Shop Companies.—Nearly all the great shop businesses, those especially in London, are now run by limited companies. The individual shopkeeper is giving place to the joint stock company, and the tendency is towards amalgamation. Several of the leading industrial companies have now published the results of their operations for 1906, and *The Economist* summarizes the results in a series of useful tables. Speaking generally, last year was a very favourable period for the big shops of London. Taking the large and representative companies, the figures show an aggregate profit for the twelve months of £732,628, which compares with £686,835 in 1905, thus showing an increase of £45,793, or 6·7 per cent. Only two companies earned less than in the previous year, and in neither case was the shrinkage sufficient to affect dividends. At present prices the yields of the shares of these companies look tempting, ranging as they do from 4⅝ to 8 per cent., but the way in which the balance-sheets generally are drawn up leaves a good deal to be desired. The good-will is not stated separately, and, as a rule, though most of the ten companies set out substantial sums as reserve funds, they are not represented by separate investments.

CORRESPONDENCE.

Law Society's Hall,
Chancery Lane, London, W.C.
14th February, 1907.

Dear Sir,

It may interest you to know that a year ago, after the issue of the new e i on of the Report of the Committee of the Society of Arts on Leather

for Bookbinding, I caused the bookbinder who binds and repairs for this Library to obtain from his manufacturers a guarantee that all skins supplied to him are "sumach tanned and dyed and finished in same style as those which Dr. Gordon Parker analysed and of which we sent you a report."

The report referred to, of which I have a copy, was made in June, 1903, and states that three samples of leather submitted to Dr. Gordon Parker (being respectively brown, blue and red skins) "are all first-class moroccos . . . . free from any trace of mineral acids . . . . eminently suited for bookbinding purposes."

The leathers now used in this Library are: *Pigskin*, half binding with buckram, for heavy volumes; *Morocco*, half binding, for legal text-books and works of reference in constant use; *Coloured Calf*, whole and half bindings, for sets of law reports, law magazines, and other serials.

For old editions of text-books, kept only for reference and very seldom looked at, I am now using "art linen," which is strongly recommended by the binder and looks neat. I cannot yet say whether it lasts well.

"Law calf" was formerly much used here, but it was abandoned about 20 years ago, and its place has been taken, with satisfactory results, by the "coloured calf."

The rooms are now heated with hot-water pipes, as well as with open fire places. The electric light only is used.

Yours faithfully,
WALLER M. SINCLAIR,
Librarian.

Sir Henry Trueman Wood, M.A.,
The Secretary
The Society of Arts,
John-street, Adelphi, W.C.

GENERAL NOTES.

THE SOUTH AFRICAN PRODUCTS EXHIBITION.—This Exhibition is interesting not only from the character of its exhibits, but as showing that notwithstanding sharp differences the South African Colonies are prepared to act together upon occasion. The Cape Colony, Natal, the Transvaal, the Orange River Colony, and Rhodesia have combined to make the Exhibition a success, and to bring before the people of this country the products of South Africa. Perhaps the most important exhibit is that of cotton, grown on the eastern slopes of the Drakensberg. A ton and a-half of it has come over, only samples having reached England before, and its quality warrants the hope that by-and-bye South Africa will supply a substantial portion of Lancashire requirements. Another interesting exhibit is that of Cape wines. Of late years the trade in these wines with this country has been insignificant, why, it is perhaps difficult to explain. They were known many years before the Australian product found a market here, and it is claimed for them that, being less heavy, they should find a readier sale. However that may be, the present exhibition, as displayed by that veteran grower, Mr. Sedgwick, should do something towards quickening inquiry. Cape Colony makes a feature of the ostrich-feather farming, and there is a very attractive group of stuffed birds, the male, female, and their young. There are also fine specimens of the feathers. An important section of the Exhibition is that of fruits. The apricots are specially noticeable, some being from the Rhodes fruit farms, semi-dried as in California. Perhaps the least successful fruit exhibit is the pine apples from Natal. They are small and withered looking, and the mangoes, exhibited by the same colony, are not very attractive, being too green. The wonderful mineral wealth of the Transvaal is given a prominent place in the Exhibition, and the coal section is especially noticeable. The exhibits of tea are interesting. First grown at Kearsney, near the Zulu border, it is now being planted over a large area up to an altitude of 1,000 feet. There is already a considerable export trade which bids fair to grow rapidly. The Orange River Colony exhibits are mostly confined to cereals and dairy produce. Wool, of course, occupies a prominent position in the Exhibition, and the exhibits at the stall of the Women's South African Industrial Union deserve notice. So, too, the tobacco exhibits of Rhodesia. Altogether, the Exhibition is a very interesting one, and it is pleasant to note how Dutch and English have combined to make it a success.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MARCH 13.—"Mediæval Stained Glass, its Production and Decay." By NOEL HEATON, B.Sc. LEWIS FOREMAN DAY, F.S.A., Vice-President of the Society, will preside.

MARCH 20.—"Smoke Prevention in Factories and Electric Supply Stations." By JOHN B. C. KERSHAW, F.I.C. SIR JOSEPH W. SWAN, M.A., F.R.S., will preside.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MARCH 14.—"The City of Madras." By SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras. The LORD AMPTHILL, G.C.S.I., G.C.I.E., will preside.

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

April 23.—"The Mineral and other Resources of Western Australia." By the HON. C. H. RASON, Agent-General for Western Australia.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

MARCH 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. LAURIE, M.A., Principal of the Heriot-Watt College, Edinburgh.

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. HALSEY RICARDO will preside.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

F. HAMILTON JACKSON, "Romanesque Ornament." Three Lectures.

LECTURE III.—MARCH 11.—Anglian carvings, — The Lindisfarne gospels — Italian workmen and influence in Northumbria—Anglian ornament based on classical data — Later Comacines, called Lombards, and their activity—Italians in Germany and Byzantine influence on the Rhine—The goldsmiths of the Lower Rhine and the Meuse — Byzantine underlying forms and germs of 12th century patterns —English MSS. of the 10th and 11th century—Details which appear in later ornament—Reciprocal influence of England and Germany, and early influence of England upon France—English and Scots missionaries—The cloister the cradle of Romanesque — English and other ecclesiastical craftsmen, and work done by them—Summing up.

PROF. HERBERT JACKSON, F.I.C., F.C.S, "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 11...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Mr. F. Hamilton Jackson, "Romanesque Ornament." (Lecture III.)

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. (Graduates' Section.) Mr. Harold Broughton, "Notes on the Design and Equipment of Electric Travelling Cranes."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. Mark Sykes, "Journeys in Turkey and Asia."

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 12...Hellenic Studies, in the Rooms of the Society of Antiquaries, Burlington-house, Piccadilly, W., 5 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Professor W. Stirling, "The Visual Apparatus of Man and Animals." (Lecture V.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on Mr. A. P. Trotter's paper, "The Construction of Overhead Electric Transmission-Lines."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Hon. C. H. Rason, "Western Australia and its Resources."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, MARCH 13...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Noel Heaton, "Mediæval Stained Glass, its Production and Decay."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Geological, Burlington-house, W., 8 p.m. 1. Prof. Sidney Hugh Reynolds, "A Silurian Inlier in the Eastern Mendips." 2. James Archibald Douglas, "Changes of Physical Constants which take place in certain Minerals and Igneous Rocks, on the Passage from the Crystalline to the Glassy State; with a short Note on Eutectic Mixtures."

Japan Society, 20, Hanover-square, W., 8½ p.m. Mr. J. C. Hall, "Early Feudal Law in Japan."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3½ p.m. Annual Meeting.

THURSDAY, MARCH 14...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir James Thomson, "The City of Madras."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. C. W. Saleeby, "Biology and Progress." (Lecture I.)

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, MARCH 15...Royal Institution, Albemarle-street, W., 9 p.m. Prof. G. Lunge, "Problems of Applied Chemistry."

North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7½ p.m. Mr. R. J. Walker, "The Development of the Turbine."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "The Reciprocal Influence of Eastern and Western Art."

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. W. Worby Beaumont, "Petrol Motor Omnibuses."

SATURDAY, MARCH 16...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Röntgen, Cathode, and Positive Rays." (Lecture V.)

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FRIDAY, MARCH 15, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

TUESDAY, MARCH 19, 8 p.m. (Applied Art Section.) Dr. A. P. LAURIE, M.A., "Oils, Varnishes, and Mediums used in the Painting of Pictures."

WEDNESDAY, MARCH 20, 8 p.m. (Ordinary Meeting.) JOHN B. C. KERSHAW, F.I.C., "Smoke Prevention in Factories and Electric Supply Stations."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

Mr. F. HAMILTON JACKSON, Vice-President of the Society of Designers, delivered the third and last lecture of his course on "Romanesque Ornament," on Monday, 11th inst.

Mr. LEWIS DAY, Vice-President of the Society (the Chairman), proposed a vote of thanks to Mr. Jackson for his course, which was carried unanimously.

The lectures will be published in the *Journal* during the summer recess.

INDIAN SECTION.

Thursday afternoon, March 14; LORD AMPTHILL, G.C.S.I., G.C.I.E., in the chair.

The paper read was "The City of Madras," by SIR JAMES THOMSON, K.C.S.I., M.A., late Member of Council, Madras.

The paper and report of the Discussion will be published in a future number of the *Journal*.

ALBERT MEDAL.

The Council will proceed to consider the award of the Albert Medal for 1907 early in May next, and they, therefore, invite members of the Society to forward to the Secretary, on or before Saturday the 6th April, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting Arts, Manufactures, and Commerce," and has been awarded as follows in previous years:—

In 1864, to Sir Rowland Hill, K.C.B., F.R.S.

In 1865, to his Imperial Majesty, Napoleon III.

In 1866, to Michael Faraday, D.C.L., F.R.S.

In 1867, to Mr. (afterwards Sir) W. Fothergill Cooke and Professor (afterwards Sir) Charles Wheatstone, F.R.S.

In 1868, to Mr. (afterwards Sir) Joseph Whitworth, LL.D., F.R.S.

In 1869, to Baron Justus von Liebig, Associate of the Institute of France, For.Memb.R.S., Chevalier of the Legion of Honour, &c.

In 1870, to Vicomte Ferdinand de Lesseps, Member of the Institute of France, Hon. G.C.S.I.

In 1871, to Mr. (afterwards Sir) Henry Cole, K.C.B.

In 1872, to Mr. (afterwards Sir) Henry Bessemer, F.R.S.

In 1873, to Michel Eugène Chevreul, For.Memb. R.S., Member of the Institute of France.

In 1874, to Mr. (afterwards Sir) C. W. Siemens, D.C.L., F.R.S.

In 1875, to Michel Chevalier.

In 1876, to Sir George B. Airy, K.C.B., F.R.S., Astronomer Royal.

In 1877, to Jean Baptiste Dumas, For.Memb.R.S., Member of the Institute of France.

In 1878, to Sir Wm. G. Armstrong (afterwards Lord Armstrong), C.B., D.C.L., F.R.S.

In 1879, to Sir William Thomson (now Lord Kelvin), O.M., LL.D., D.C.L., F.R.S.

In 1880, to James Prescott Joule, LL.D., D.C.L., F.R.S.

In 1881, to August Wilhelm Hofmann, M.D., LL.D., F.R.S., Professor of Chemistry in the University of Berlin.

In 1882, to Louis Pasteur, Member of the Institute of France, For.Memb. R.S.

In 1883, to Sir Joseph Dalton Hooker, K.C.S.I., C.B., M.D., D.C.L., LL.D., F.R.S.

In 1884, to Captain James Buchanan Eads.

In 1885, to Mr. (afterwards Sir) Henry Doulton.

In 1886, to Samuel Cunliffe Lister (afterwards Lord Masham).

In 1887, to HER MAJESTY QUEEN VICTORIA.

In 1888, to Professor Hermann Louis Helmholtz, For.Memb.R.S.

In 1889, to John Percy, LL.D., F.R.S.

In 1890, to Dr. (now Sir) William Henry Perkin, F.R.S.

In 1891, to Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S.

In 1892, to Thomas Alva Edison.

In 1893, to Sir John Bennet Lawes, Bart., F.R.S., and Sir Henry Gilbert, Ph.D., F.R.S.

In 1894, to Sir Joseph (now Lord) Lister, F.R.S.

In 1895, to Sir Isaac Lowthian Bell, Bart., F.R.S.

In 1896, to Prof. David Edward Hughes, F.R.S.

In 1897, to George James Symons, F.R.S.

In 1898, to Professor Robert Wilhelm Bunsen, M.D., For.Memb.R.S.

In 1899, to Sir William Crookes, F.R.S.

In 1900, to Henry Wilde, F.R.S.

In 1901, to HIS MAJESTY THE KING.

In 1902, to Professor Alexander Graham Bell.

In 1903, to Sir Charles Augustus Hartley, K.C.M.G.

In 1904, to Walter Crane.

In 1905, to Lord Rayleigh, O.M., D.C.L., Sc.D., F.R.S.

In 1906, to Sir Joseph Wilson Swan, M.A., D.Sc., F.R.S.

A full list of the services for which the medals were awarded was given in the last number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

FOURTEENTH ORDINARY MEETING.

Wednesday, MARCH 13th, 1907; LEWIS FOREMAN DAY, F.S.A., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Anderson, James D., 17, Blakesley-avenue, Ealing, W.

Booth, Rev. James Henry, F.R.G.S., Maryport, Cumberland.

McIlwraith, Sir Malcolm, K.C.M.G., Ministry of Justice, Cairo, Egypt.

MacLean, John, 330, Smith-street, Winnipeg, Canada.

Muff, Henry, The Red House, Bexley Heath, Kent.

Wyllie, Herbert D., Cameron Septic Tank Co., 812 & 813, Monadnock Block, Chicago, Illinois, U.S.A.

The following candidates were balloted for and duly elected members of the Society:—

Charlesworth, Charles Dixon, 72, Egerton-road, Withington, Manchester.

Euba, Rev. W. B., Wesleyan High School, Marina, Lagos, West Africa.

Firminger, Rev. Walter K., B.D., M.A., Kidderpore Vicarage, Calcutta, India.

Robertson, Vincent Leopold, Rolfontein, P O. Amersfoort, Transvaal, South Africa.

Tebb, William Scott, M.D., Sandfield, Putney Heath-lane, S.W.

Wallace, Captain William Thomas Ewart, Entebbe, Uganda Protectorate, British East Africa.

The paper read was—

MEDIÆVAL STAINED GLASS: ITS PRODUCTION AND DECAY.

By NOEL HEATON, B.Sc.

I am not going to attempt to-night to give you a complete account of the methods of mediæval glass painting, but to draw attention to various points connected with this subject which I have recently had an opportunity of studying. My inquiries, conducted in the brief intervals of daily work, have been of necessity spasmodic and incomplete, but I venture to put before you the conclusions at which I have arrived in the hope that they may be of some interest, and that they may be favoured with your discussion and especially your criticism. Before entering on my subject, however, I propose, with the indulgence of those of you to whom such things are perfectly familiar, briefly to recapitulate the main facts concerning the composition and manufacture of glass, in order to render clearer the points on which I wish to invite discussion, to those of you who may not have had the opportunity of studying such matters.

In the following Table I have attempted to give a summary of the main principles of glass making*:—

The principal constituent of glass, from which most of its characteristic properties are derived, is the substance silica, found in almost all rocks, and occurring almost pure in such substances as quartz, flint, &c. Nowadays fine white sand, which is almost pure silica, is generally employed as its source in glass-making.

* It will be understood that I have only touched upon this on the broadest lines with a view to exhibiting the relations between the various materials to which I shall have occasion to make frequent reference.

TABLE I.—THE COMPOSITION OF GLASS.

Class.	Substance.	Composition.	Source.	Function.	Faults.	Type. Potash lime.	Soda lime.	Flint.
Acid	Silica	SiO_2	Quartz Flint White sand	Glassy nature	Infusibility	70	70	43
Alkalies	Potash Soda	K_2O Na_2O	Wood ashes Glaubers salt, &c.	Fusibility	Solubility	15 —	— 15	12 —
Alkaline earths	Lime Baryta Magnesia	CaO BaO MgO	Chalk Barytes Limestone	Brilliancy Durability	Tendency to devitrify	13	13	—
Earths ..	Alumina Iron Manganese	Al_2O_3 Fe_2O_3 MnO	Clay — Black oxide	Brilliancy — Corrects colour	Excessive hardness Colour [?]	2	2	2
	Lead oxide	PbO	Red lead	Optical qualities	Softness and weight	—	—	43

Silica possesses in a very marked degree all those qualities which one looks for in glass, with one serious drawback, that it only becomes plastic at a temperature far too high for the ordinary conditions of working.

Glass, in fact, is silica, rendered more fusible by combination with other substances.* These substances are, in the first place, the alkalies, potash and soda. These two alkalies, potash and soda, are very similar in their properties and yet have important differences. The name potash, by the way, is a contraction of pot-ashes, because it was originally obtained by collecting the ashes of burnt wood in an iron pot and extracting the salts with hot water. Potash, it is important to remember, is the principal ingredient of the ash that remains after burning any land vegetation. Soda, on the other hand, is chiefly marine in origin, being the principal constituent of sea salt and of course our common table salt, which is derived from it.†

Unfortunately, these alkalies, although capable when heated with silica, of combining with it to form a fusible glass, are unable to accomplish this without rendering it useless in another direction, the glass so made being soluble in water and easily disintegrated by exposure to the weather. In order to counterbalance this tendency we have recourse to the bodies known as alkaline earths, which, combined with the materials already mentioned, yield a practical glass, which is both fusible and insoluble. Where a glass is required which will be extremely resistent, alumina, the oxide of the metal aluminium, may be used, but this makes the glass exceedingly hard if added to any great extent. These are all the essential constituents of white glass—you see, however, I have also included iron and manganese in the list. They are not wanted, but except in special cases where great care is taken to exclude it, iron always manages to find its way into glass, as an impurity in one of the ingredients, and gives a colour to the glass which, when pure white glass is required, is generally counteracted by the addition of manganese.

It is also possible to produce a satisfactory glass in another way, by means of lead, which can be used instead of the earths; we do not, however, find lead used for glass-making during the mediæval period.

It is not necessary to have all these materials present in a glass, but it is necessary to have silica, one alkali, and one of the earths or lead—several kinds of glass are, therefore, possible, but in practice three types are generally recognised, namely: — Potash-lime, the mediæval type; soda-lime, its modern equivalent; potash-lead, modern flint glass.

* This is only strictly true of such glasses as are commonly used for domestic purposes. There are other varieties of glass—such as those used for optical purposes, and for making enamels—where silica may be largely replaced by its congener boron oxide. But these belong to a different category, and do not come within the scope of my paper.

† The chief source of soda in ancient times was Natron, a natural carbonate of soda, which occurs as a deposit on the sides of several lakes to the west of the delta of the Nile. The name alkali which includes both potash and soda, is derived from Kali, the name given by the Arabs to a plant which they used extensively as a fuel. The ashes from the fires so made they collected and sold to the Venetians for glass making. "Of the glass we use the purest is made of the ashes of chali or glasswort" (Sir Thomas Browne, "Vulgar Errors.")

This, of course, all has reference to white glass; the production of coloured glass I do not propose to touch upon.

Turning now to the various methods employed to make the glass into the flat sheets in which it is required by the glass painter, these may be divided into three:—

1. The simplest and, therefore, probably the earliest method, was that generally employed by the Romans for making window glass, namely, by just pouring the molten glass on to a hot marble or metal slab.

2. The next method, the one most commonly employed by mediæval glass painters, consisted of blowing the glass into a bulb, manipulating this until it took the shape of a cylinder, and, by a subsequent operation, opening this cylinder out into a flat sheet; this is generally known as "muff" or cylinder glass.

3. Then we have the spun or crown glass, which begins in the same way as the muff, but ends in the formation of a flat circle with a boss, or bullseye as it is called, in the centre.

Now, there are two curious things about these different methods of making glass into sheets. One is that the Romans, who were capable of doing almost anything with glass, are generally supposed to have been unable to make, or at any rate not to have made, window glass in any other way than by casting it into sheets in the way I have described. It is surprising, I think, that they should have stopped there, in view of the fact that they made window glass purely for utilitarian purposes, for which the blown glass is far superior to the rough cast glass that they used. Now, on the contrary, the mediæval craftsmen were indifferent glass makers, and I think it equally extraordinary that they should jump straight away to the comparatively difficult process of making muff glass; yet the earliest direct evidence we have as to their methods, the well-known treatise of Theophilus, describes, clearly and unmistakably, the "muff" process as the way to make glass in sheets.

As regards the first fact, quoted categorically by all writers on the subject that I have seen, that Roman window glass was invariably cast, the explanation is simple—it is not true. The Romans undoubtedly knew how to make muff glass, and muff glass of Roman make was used in England. It was probably a much later development than the cast glass they more generally employed, it is certainly a much better and finer glass, but it certainly existed. I do not wish to go into this point at length because it is somewhat wide of my subject, but I would like those interested in the matter to examine this specimen of undoubted Roman window glass from Silchester, which, by the courtesy of Mr. G. H. Fox, to whose kindness I owe my ability to make this statement, I am enabled to show you.

I think I may assume then that the Romans made "muff" glass, and this might perhaps explain away the second difficulty I referred to by assuming that the art of making this glass was handed down through the dark ages of which we know so little. I scarcely think this is probable however; to give one reason, the mediæval glass itself is far inferior to the Roman, and made with quite different materials, whereas one would expect that if the manipulation were handed down, the process of manufacture would be also.

No, I believe that the mediæval glass must be taken by itself, and I think it most probable that it originated in the first instance in the simple process of pouring the glass on to a slab. In the absence of sufficient evidence I should be sorry to state this as a fact—unfortunately authentic specimens of stained glass earlier than the thirteenth century are not common, and it is exceedingly difficult to procure isolated fragments for examination; but I possess one specimen of early thirteenth century glass, which I am quite convinced was made in this way—this fragment here—which came from Noyon in France.*

As regards the spun glass, it appears to date back as far as the muff—which came first I cannot say; it is quite possible that one developed out of the other almost simultaneously. One finds muff and spun glass side by side in the late twelfth and thirteenth century windows, muff glass generally employed for white, blue, yellow, and flesh glass which were used in quantity, and spun for ruby and the finer colours.

But to return to the matter of the making of the glass, as regards the actual ingredients employed and the composition of the glass resulting.

The earliest account we have of this is the celebrated treatise of Theophilus, to which I have already alluded, wherein we read:—

"If it pleases you to make glass, first cut up much beech wood and dry it well. Then burn it equally in a clean spot, and diligently collecting the ashes, be careful not to mix any dust or stones with them. . . . ."

* This specimen was sent to me by my brother, Mr. Clement Heaton, of Neuchatel.

"Then taking two parts of the ashes of which we have spoken above, and a third of sand, carefully purified from earth and stones, which sand you shall have taken out of water, mix them together in a clean place."*

On the face of it then, the making of mediæval glass was perfectly simple. One can readily understand, however, that as to whether the glass was good or bad, a great deal depended upon the actual composition of these two ingredients, wood-ashes and sand. Of course, one must be careful not to take the word of a single mediæval writer as representing all that could be said on the subject. What probably happened was this: that it being established as a general principle that glass could be made from sand and the ashes of plants (which are as I have said a source of alkali); then, whatever could best be obtained—beechwood, bracken, seaweed, or other vegetation would yield the ashes, and the nearest local deposit the sand.

Now, turning to the composition of wood-ashes, we find these words in a recent publication:—

"The composition of wood ashes is extremely variable: not only do different varieties of trees have varying quantities of ash, but in the same varieties the bark and twigs yield an ash quite different in composition to that furnished by the wood." Wiley, "Agricultural Analysis," vol. ii., p. 252.

Then as regards the sand, the source of the silica, it is only under exceptional circumstances that one finds white sand such as would be considered sufficiently pure for making glass nowadays: the ordinary yellow sand, formed by the disintegration of siliceous rocks, is not pure silica, but contains a varying proportion of other substances present in such rocks, namely, the earths, especially alumina. It is pretty certain then that mediæval glass varied very considerably in composition. Of course, this is nothing new, you probably have all heard it before. Considering these facts, however, one would expect mediæval glass to reveal on analysis a fairly complicated composition, and whilst varying considerably to show in general a richness in alkali (usually potash) and poorness in lime.

I have often contemplated the carrying out of a series of complete analyses of typical specimens of this glass, in order to obtain some information as to the relation of composition to decay, but have been prevented by the limited time and facilities at my disposal. One reads in Winston and other books on stained glass of numerous analyses of mediæval glass having been made. I have failed myself, however, to discover any detailed record of such work. When, therefore, an old friend of mine, Mr. Percy Williams, B.Sc., offered his assistance in this matter, I gladly availed myself of the opportunity.

As Mr. Williams possesses exceptional skill and experience in complex silicate analysis, and happened at the time to be particularly well placed for carrying out such tedious work, I place the results before you with far greater confidence in their absolute accuracy, than I should if I had attempted the work myself.

Two typical specimens of glass were taken, for both of which I am indebted to Mr. W. H. St. John Hope. The first was a fragment of some typical fourteenth-century glass from Sandiacre, in Derbyshire. This glass was in a very good state of preservation, as you see from this little panel, which contains some larger pieces of the same glass. The other specimen was some glass that had remained buried since the Reformation until dug up in 1882. It came from Dale Abbey, in Derbyshire. I consider it to be late thirteenth century, but as you see it is so much decomposed as to make it a matter of difficulty to determine. Here is a complete analysis of each specimen, and by the side I have noted, for comparison, what is considered to be the normal composition of modern window glass:—

TABLE II.—Composition of Mediæval Glass.

Material.	Sandiacre.	Dale Abbey.	Modern window glass
Silica	54·01	46·94	70
Phosphoric acid	4·18	4·11	—
Potash	13·20	16·96	15 (Potash and Soda)
Soda	1·70	0·12	
Lime	17·37	19·01	13 (Lime and Magnesia)
Magnesia	5·33	5·00	
Alumina	2·41	3·02	2 (Alumina, Iron and Manganese)
Iron	0·81	1·46	
Manganese	1·03	1·37	
Moisture due to decay	0·21	2·16	—

You see in each case the low content of silica as compared with modern practice; then you will notice that in each case the alkali is practically all potash, due to the use of wood ashes as I have already explained. There seems no doubt, by the way, that to this

* Theophilus. Book II., chapter I and IV.

use of potash instead of soda must be ascribed the glorious effect of staining obtainable in mediæval glass. It is not true that one cannot stain a soda glass, but the stain is much colder and harsher in the modern glass invariably made with soda. I am afraid, however, I must not stop to discuss this interesting question of stain to-night.

There are two points in these analyses to which, however, I would especially direct your attention. The first is the abnormal proportion of lime and magnesia, together amounting to 24 per cent. in the one case and nearly 23 per cent. in the other. I shall have occasion to refer to this point further in connection with the decay of the glass. In the second place I would draw attention to the presence of 4 per cent. of phosphorus in each case. This is rather an interesting matter in more than one direction, and so far as I am aware has not hitherto received attention.

In the first place it points to the fact that this glass was made in just the same way as described by Theophilus, that is, with crude wood ashes and sand. I think it has hitherto been considered somewhat doubtful whether or not the mediæval glass painters were accumstomed to purify their wood ashes before use. The presence of phosphorus in the glass, taken in conjunction with the large quantity of lime, suggests very strongly that this was not the case.

Owing to the extremely varying composition of wood ashes it is difficult to arrive at anything like a typical composition as regards quantities, but after potash the principal ingredients are the phosphates of lime and magnesia, which may amount to anything up to 40 per cent., in these, according to Liebig, the ash of beechwood is exceptionally rich. These insoluble substances would of course be left behind on lixiviating the ash to obtain the potash, and glass made with such purified alkali would contain no phosphoric acid.

The presence of phosphate of lime in this glass is interesting from another point of view. You know it is customary to speak of mediæval glass as being of a horny texture, and this texture is generally ascribed to its having been very imperfectly melted. For example, Winston says:—

"The difference . . . . . between modern and ancient glass is, I believe, occasioned by our using purer materials than the ancients did, and furnaces of greatly improved construction, which insures a more perfect fusion and amalgamation of the vitreous particles than perhaps could have been effected in the older furnaces."*

To judge from such mediæval glass as I have had the opportunity of carefully examining, however, I do not altogether agree with this: the glass seems generally well melted and homogeneous, although crudely blown. At the same time there is undoubtedly a peculiar opalescence or horniness about this glass which is not found in its modern equivalent.

Compare, for instance, the quality of the Sandiacre glass with the label beneath it, painted on modern "antique." This is just the quality that one would obtain by adding a small amount of phosphate of lime to the glass. I have here a lamp globe, for example, the peculiar opalescence of which is obtained by the addition of bone ash, that is, phosphate of lime, to the glass mixture.†

Then, from the point of view of the chemist, this presence of phosphorus in the glass is of interest. Taken in conjunction with the small amount of alumina and the large amount of lime, it renders the process of analysis very troublesome.

The importance of this point lies in the fact that if a partial analysis of the glass is made—with a view of determining the amount of alumina for example, or, if an analysis is attempted without the possibility of the presence of phosphorus being recognised, the results are liable to be seriously inaccurate.

In the case of an ordinary earth containing phosphorus, the ordinary method of analysis would not be interfered with, because the amount of phosphoric acid would be small relatively to the iron and alumina. The whole of the phosphorus in such a case would be carried down by the iron and alumina, leaving the alkaline earths to be dealt with in the usual way.

In the present instance, however, the reverse is the case—the iron and alumina are insufficient to bring down all the phosphoric acid, and the remainder would bring down part of the lime in this group. The analysis therefore would show much too high a content of alumina, and too low a percentage for lime. In order to obviate this difficulty Mr. Williams employed the following method of analysis:—

About 1 gramme of the glass was fused with five times its weight of fusion mixture, being first warmed

* "Inquiry," page 271.

† I am indebted to Mr. R. Plant, of the Soho Glassworks, Birmingham, for this specimen, and for showing me its process of manufacture in operation.

over a small luminous flame for a quarter of an hour, then over a bunsen flame for a quarter of an hour, and finally heated with a gentle blast for forty-five minutes.

After cooling, the platinum crucible containing the melt was digested for about three hours over the water-bath, and the contents washed out into a large platinum basin. The basin was covered with a watch glass, and 10 c.c. of pure nitric acid, previously diluted with 10 c.c. of water, introduced; it was then warmed over the water-bath, until the contents were completely disintegrated. The insoluble silica was then found to be strongly coloured by insoluble manganese dioxide; in order to reduce this and bring it into a soluble condition, the contents of the platinum basin were treated with about 1 c.c. of formic aldehyde. The reduction of the manganese proceeded slowly and was taken as being complete when the silica became perfectly colourless. The contents of the basin were then evaporated to dryness and finally heated in the air oven to 120°. After cooling, the dried residue was again digested with nitric acid (10 c.c. pure nitric acid diluted with 10 c.c. water), diluted, filtered, and the insoluble silica determined in the usual way. In order to correct for any soluble silica that might have passed into the filtrate, this was then again evaporated to dryness and taken up with nitric acid, the precipitate being added to the previous one. The final filtrate from the silica was then evaporated to dryness to expel nitric acid, and afterwards taken up with water and only sufficient nitric acid to ensure complete solution of the phosphates. This solution was washed into a flask, warmed over the warm bath, and treated with hydrogen sulphide to determine any traces of the metals of the lead group. After eliminating any dissolved hydrogen sulphide, it was allowed to cool and treated with excess of silver carbonate, well shaken during several hours, and filtered. The filtrate, after removing excess of silver with hydrochloric acid, contained the alkaline earths, which were determined according to usual practice. The precipitate contained the iron and alumina, all the phosphorus, and excess of silver carbonate. It was dissolved in nitric acid, the solution being then treated with hydrochloric acid to remove the silver, filtered, and precipitated with ammonia. This precipitate now consisted of the iron and alumina, combined with part of the phosphorus. The iron in this mixture was then determined, and also the phosphorus, and the alumina calculated by difference. The total content of phosphorus was subsequently estimated in a separate portion of the glass.

For purposes of comparison I now give you a typical analysis of the glass used by the glass painter at the present day—what is known as "Antique." This analysis I would remark, is not that of any particular specimen, but what you might describe as a fair sample of the type of glass. I collected specimens of white antique from various cutting shops, and reduced them to powder, making an intimate mixture of the whole, from which the specimen analysed was drawn.

TABLE III.

	"Antique." (Average.)	Mediæval. (Average.)	Normal window glass.
Silica..	67·1	50·47	70
Phosphoric acid.	—	4·15	—
Sulphuric acid ..	0·6	—	—
Potash	0·7	15·08	15 (Potash and Soda)
Soda	12·5	0·91	
Lime	12·5	18·19	13 (Lime and Magnesia)
Magnesia	0·1	5·16	
Alumina	5·0 (Alumina and Iron)	3·85	2 (Iron and Manganese)
Iron			
Manganese ..	0·1	1·20	
Lead oxide ..	1·3	—	—

You see it is a much more normal glass according to our ideas.. The alkali is almost entirely soda, probably added in the making as sulphate of soda, to judge by the fact that a percentage of sulphur is found in the glass. The 1 per cent. or so of lead is probably due to the addition of cullet, containing some flint glass, to the batch. Side by side with this analysis I have placed the figures given by taking the mean between the two mediæval glasses previously shown.

But my original object in collecting these analyses was with a view to determine the relation between composition and decay, and I must now pass on to the consideration of this matter.

Mediæval glass, as you are aware, decays in a very characteristic manner. Very commonly the glass becomes covered with little pits, for all the world like the worm holes one often sees in an old oak cabinet; the appearance is, however, too well known to you to need description. The reason for this peculiar behaviour seems to have been often speculated upon, but rarely inquired into. The pitting of the surface has been likened to small-pox, and I remember a few years ago, when some of the York windows were undergoing repair, an alarming account of their condition appeared in one of the daily papers, from which it appeared that this pitting was due to a malignant microbe which started a regular disease through the glass. Of course, this probably originated in a practical joke on the part of one of the artists in charge of the restoration; but I have seen suggestions almost

as wide of the mark put forward quite seriously and quite recently.

So long ago as 1879, however, a paper was contributed to the Society of Antiquaries* on this subject, which. although incorrect in many details and somewhat unnecessarily complicated, gives a very complete survey of the matter. It is much to be regretted that the large number of examples collected together in illustration of this paper were not kept together for future reference, and are now only to be judged by the brief descriptions of them there given.

The process of decay in glass is undoubtedly a parallel on a small scale to the change produced on a large scale by the action of time and weather on geological formations, such as chalk and sandstone—a combination of corrosion and internal change. In fact, to study the decay of glass is to study structural geology under the microscope, to put it metaphorically.

In the first place, glass—especially that made with potash, as all mediæval glass was—is hygroscopic, attracting moisture to its surface, so that except in a very dry climate it is never perfectly dry, but covered with a film of moisture. This water immediately attacks the surface of the glass, extracting the alkalies from the alkaline silicates, and leaving the silica behind. Of course, this action is very slight, but it is quite possible to demonstrate that it takes place by leaving glass even for a few minutes in contact with moisture.†

Allow this process to go on unchecked for year after year, century after century, accelerated by actual exposure to rain, frost, and snow, by the presence of acids dissolved in the water, and by continual variations of temperature, and you will find that the effect of the action accumulates until the whole surface of the glass gradually becomes corroded away, as you can see it is in this specimen of the glass from Sandiacre. The alkalies being entirely extracted from the surface the silica is left behind, and in glass exposed to the weather, as this has been, is washed away. If, however, the glass is not exposed to actual washing—if it is buried for instance—the silica remains on the surface in a thin film, so thin that like the soap bubble it interferes with the light passing through it, producing that irridescence which is so admired on specimens of ancient buried glass. It is only very rarely, however, and under exceptional circumstances, that mediæval glass becomes irridescent by corrosion, an this is due to the large proportion of lime it contains as compared with the silica and alkali. On the extraction of the alkali by water this lime is left behind with the silica and forms with it a hard insoluble silicate of lime, which adhers to the corroded surface of the glass, forming an opaque scum or patina, as is also well illustrated by this Sandiacre glass. In some cases this is so marked that the glass appears to be covered with a coat of cement. There are instances of this, for example, in some of the glass from the Sainte-Chapelle in the Victoria and Albert Museum, of which by the kindness of the authorities I was recently enabled to make a careful examination.

This scumming of the glass has given rise to the suggestion, put forward by Winston and others, that mediæval glass was sometimes coated with mortar when first made in order to imitate decay. I submit to you that mine is the more tangible explanation. I have no doubt that the craftsmen of the Middle Ages were capable of such a thing if it occurred to them, but I think we must give them the credit of being ignorant of modern ideas of faking, and of descending to such mean and unworkmanlike tricks.

So much, then, for the direct corroding effect of the atmosphere on glass. Side by side with this corrosion of the surface we find that exposure to weather and variations of temperature has another indirect influence, which produces internal change. You must remember that glass is not a definite chemical compound, but an indefinite mixture of different silicates.

It is well known that if glass is kept for a length of time at such a temperature that it is just plastic, its constituents tend to separate out into definite compounds, which crystallise out from their matrix in the same way as any salt will crystallise out from solution, until in time the glass changes entirely into an opaque, crystalline mass, generally known as Réaumur's porcelain, because Réaumur conceived the idea of utilising this action to produce articles having a general resemblance to porcelain.

Now it sometimes happens that glass com-

* "The Process of Decay in Glass."—James Fowler, F.S.A., Archæologia, vol. xlvi.

† An electroscope mounted on glass insulators will not retain a charge of electricity for any length of time in an ordinary room; if, however, precautions are taken to keep it absolutely dry it can be kept charged for a considerable period. This is due to the fact that in the first case the film of moisture on the glass attacks it and becomes alkaline, so providing a conducting surface along which the charge can escape.

mences to crystallise out in this way whilst it is being worked, from various causes affecting the working of the furnace. The glass-blower's name for this state of affairs is that the glass has turned "ambitty." This accident has been turned to account in the production of a glass called ambitty sheet, with which all glass painters are familiar; it is very extensively used for domestic plain glazing. The peculiar texture of this glass is due to the presence of numerous minute crystals, which can readily be distinguished with a pocket lens, whilst the microscope reveals the presence of several distinct compounds with definite crystalline forms.

You see then that it does not take much to make glass change its constitution, and what happens in a few hours when the glass is hot tends to take place on prolonged exposure to the atmosphere, with this difference, that when the glass is molten its molecules can freely move about, whereas, when it is cold and rigid such freedom of movement is impossible; in consequence the definite formation of crystals cannot take place, and the result of the change is different. What happens is this. In the first place molecules of the same kind tend to separate out from the homogeneous mixture and collect round a point, forming a centre of decomposition. The action in fact is just the same as the formation of concretions in sedimentary rocks—such as the formation of flint in chalk—and as you find that these concretions generally form round some object which provides a nucleus, so you generally find that if there is any irregularity such as a scratch on the surface of the glass, the decomposition will proceed along the line of that scratch.

Proceeding from this centre we find the glass decomposing into definite compounds in an ever enlarging circle until it reaches a point at which the strain set up in the glass by this molecular movement results in a crack forming round the area of decomposition and then the whole mass comes away, leaving behind it a little hole or pit in the surface of the glass. These pits are more or less circular as a rule, but frequently they grow close together and the edges unite, forming an irregular shaped hole. The pits vary in size from microscopic dimensions to a quarter of an inch in diameter, but as a general rule they are about the size of a pin's head. The most remarkable case of pitting I have ever seen is that of some of the York windows, fragments of which have been shown to me by Mr. Grylls, where the pits reach a diameter of over ⅜ths of an inch and a depth of nearly ⅛th of an inch. When pits are forming along a scratch they generally develop close together, side by side along it, and the adjacent sides break down, so that in the end we have an excavation in the shape of a long trough.

This I am convinced is the explanation of the pitted surface of old stained glass. That there certainly is a change in the constitution of the glass is shown by the fact that on digesting glass which has begun to decay in this way, in hydrochloric acid, it is possible to extract the whole of the alkalies and earths, leaving a skeleton of pure silica in the form of the original glass, whereas fresh glass of the same composition is not attacked by hydrochloric acid to any extent.

Mr. Williams, who first made this experiment, has obtained the same result with certain varieties of asbestos, which is produced by the devitrification of natural volcanic glasses. Glass devitrified by heat is also attacked by hydrochloric acid in the same way.

With the aid of the microscope one can follow out the whole process of the formation of pits in mediæval glass in the way I have described, and I now put before you several illustrations of the process, and its relation to that of devitrification.

No. 1 is a piece of Ambitty sheet glass; (*a*) natural size, showing the sparkle caused by reflection of light from numerous microscopic crystals; (*b*) magnified 20 diameters, showing three distinct crystalline compounds, the crystals having been broken up and interwoven by the manipulation of the glass. (Fig. 1.)

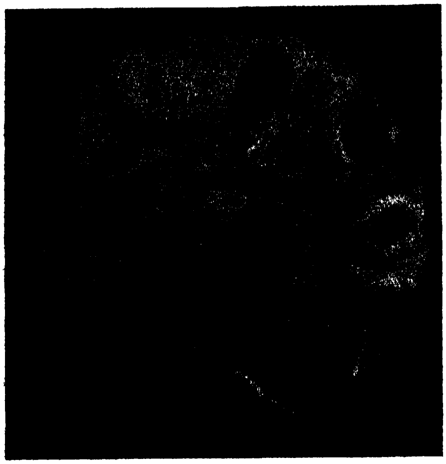
No. 2 is the fragment of early thirteenth century glass, from Noyon, magnified 20 diameters, showing long acicular crystals disseminated through it.

No. 3.—A piece of ordinary sheet window glass, which has been devitrified on the surface by heating in a glass painter's kiln for several hours. To the naked eye the surface appears covered with a multitude of circular white spots. (*a*) The upper surface, magnified 20 diameters: shewing acicular crystals growing in tufts from a centre, the strain set up by this change of formation resulting in cracks radiating from the same centres. (Fig. 2. (*b*) The under surface of the same glass, which was in contact with the bed of whitening during the heating, shewing the influence of lime on the character of the crystals.

No. 4.—A piece of flashed purple — probably early sixteenth century; the flashed

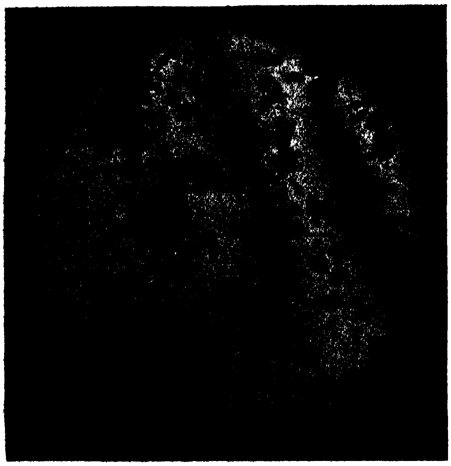
surface quite bright and free from corrosion but studded all over with numerous well defined pits, suggesting that such pits are internal rather than external in origin.

FIG. 1.



No. 5.—A fragment of stained glass from St. Peter's, Derby, shewing pits in course of formation. (*a*) Natural size. (*b*, *c*, *d* and *e*, Figs. 3, 4) Micro-photographs of pits in various stages, shewing growth from a centre in a similar manner to No. 3*a*.

FIG 2.



Such, then, are the two forces at work on the decay of glass—corrosion without and decomposition within, and of course they act simultaneously. As the pits are formed they are extended by corrosion, forming a resting place in fact for the water, until eventually the whole fabric of the glass is destroyed.

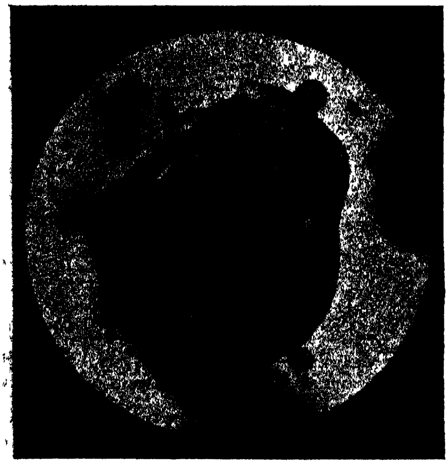
According to varying circumstances—the position of the window as affecting its degree of exposure—the climate in which it is placed —differences in composition and mechanical

FIG. 3.

state of the glass, we get all sorts of variations in the precise effect of decay in particular instances.

It is a well recognised fact that glass containing a large proportion of earths, that is, lime, magnesia, and alumina, is specially

FIG 4.



liable to turn ambitty. If, then, I am correct in thinking that the peculiar pitting of Gothic glass is due to a similar change of constitution, one would expect to find it excessively rich in these constituents, and we have already seen that this is in fact the case.

On the other hand, glass containing excess

of alkali has an equally recognised tendency to go "blind," tnat is, to become covered with a film, due to corrosion—the surface of water glass, consisting of soda and silica only, to take an extreme case, becomes roughened by corrosion in a few days. Finally, glass with a high content of silica, with earth and alkali equally balanced, may be looked upon as highly resistent in both directions. It is such glasses which decay slowly and with little tendency to devitrification, the surface being merely etched by corrosion, leaving the large proportion of silica in a coherent thin film, producing gorgeous effects of iridescence.

Of course one must not overlook the fact that apart from composition the mechanical nature of the glass has an influence on decay. Just as a geological formation of regular and uniform nature resists corrosion better than one of varying hardness and character, so a glass of uniform texture resists decay better than one of the same composition but full of variations. Now I pass on to say a few words about the "colour" as we call it, used to paint on the glass in mediæval times. If one is struck by the fact that the older the glass is the freer it seems to be from decay, how much more is this the case with the colour. On making a careful examination of the Sainte Chapelle glass to which I have already alluded, I found that the painting of the original glass was as sound and perfect as when first put on early in the thirteenth century. Here and there, however, were pieces where the paint had either gone entirely, or showed unmistakeable signs of decay, but in every single instance, careful examination revealed the fact that the glass was an insertion of later work. The most glaring case of this is one of the heads, which no one who has seen this glass can have failed to notice as being later in date than the rest of the glass. Half the paint on this head has already gone, and I would undertake to wipe the glass clean by rubbing it with a damp rag. Possibly the explanation of this may be that all the bad work of the thirteenth century has already disappeared and only the best remains, but there is no doubt that the mediæval craftsmen could make their colour so as to last remarkably well.

In this respect, however, I consider they are equalled by the best colours of to-day. But that is not all; there is a peculiar texture about the old colour, a vigour in the very finest lines, and yet a general feeling of warmth and transparency, which one has great difficulty in producing to one's satisfaction. Any hint one gets as to the method of production of this colour therefore demands careful investigation.

Now on looking through the various exchequer accounts, many of which are extant, connected with the glazing of church windows, one is struck by the constant reference to a material called "geet," bought for the purpose of painting the glass—"Geet pro pinctura vitro." The actual nature of this material does not seem to have been thoroughly inquired into, and my attention having been drawn to it in course of conversation with Mr. C. W. Whall, I thought an investigation of the matter might possibly prove to be of value.

I now want to put before you what is actually known about this material called "geet," and my conclusions regarding it, and I will begin by showing you a selection of extracts from the accounts I have mentioned :—

"Pro stangno Get et operacione fenestrarum et stipendiis de verrers usque festum sancti Michiaelis, 32s. 9¾d. Pro verre empt., £5 os. 2¼d." (Norwich Sacrist's Roll. A.D. 1274-5).

"Die Lunæ ix° die Julii. Johanni-Geddyng pro vj libris de Geet emptis pro pictura vitri vj*s*. pro cervisia empta tam pro congelacione vitri quam pro mensis vitriariorum lavandis viij*d*. Eidem pro lymatura argenti empta pro pictura vitri viij*d* Willelmo de Newerc pro cc. Talshid emptis pro vitro anellando et frangendo pretium centenæ vij*s*.-xiiij*s*. Johanni Madfray pro j. libra de Gum arebik empta pro pictura vitri iij*d*. Ricardo Thorp pro xv. centenis vitri diversi coloris pretium centenæ xl*s*.-xxx*li*. In portagio et batillagio ejusdem vitri de Temesestreete usque Westmonasterium x*d*.

"Summa empcionum xxxj*li*. ij*s*. v*d*."

(Exchequer Accounts, St. George's Chapel, Windsor, A.D. 1351-2.

"Iu xij peys vitri diversi coloris empt', xij s. In geet et lymail empt' ad vitrum, iij s. iij d." (Ely Cathedral, A.D. 1357.)

Similar references to "geet" appear in the accounts for the glazing of the windows of St. Stephen's Chapel, Westminster, which Brayley and Britton sum up thus :—

"Large quantities of stained glass of various colours, as blue, red, azure, and white, were used in glazing the windows; and silver filings, geet [probably jet], and arnement [orpiment or yellow arsenic], are mentioned among the materials procured for painting on the glass."—History of the Palace of Westminster, page 180.

To come to a later date, we have the "Booke of Sundry Draughtes," by Walter Gedde, 1615, wherein we read :—

"The Receipets, for the true making of Collours for Glasse. To make a faire Blacke. Take the Scales of Iron & Copper, of each a like waight, & put it in

a cleane vessell that will indure the fire, till they be red hotte, then take halfe as much Ieate, and stamp them into smal pouder, then mix them with Gumwater, & grind them fine vpon a painters stone and so drawe with it vpon your glasse."

And again :—

"Carnation.—Take two ounces of Tyn-glas, and six ounces of Ieat, half an ounce of gum, ten ounces of red Ocker, and grind them very well together, and so use it."

"To Make a Grey couller, take Iron scales, a little Cristall, and sum smale quantitie of Ieate, grind these well together upon a painters stone, the more Ieate ye take, the sadder the coullour will be, and likewise the more christall you put to it the lighter."

From the middle of the thirteenth century to the beginning of the seventeenth century we find this substance geet in use. It is true, however, that the treatise of Theophilus, which would be somewhat earlier than any of the dates quoted, makes no reference to it, but states that the colour is to be made of copper scales, green glass and "Greek sapphire" in equal proportions. (Book ii., chapter xix.)

The extracts quoted undoubtedly convey the impression that "geet" must be taken to mean jet—an impression strengthened by the fact that the word geet is constantly used by mediæval writers, where from the context jet is undoubtedly referred to. Hence we find that from Brayley and Britton to the present day, it has been taken for granted that the mediæval glass painter painted his glass with ground jet. But the point is not the name they gave to their material but what it was—was this stuff they called jet, what we mean by jet at the present day? On the face of it, to a practical man, it seems improbable. Let me give you a short account of jet condensed from various authorities.*

The name jet is supposed to be a corruption of "gagates," the name given to this substance by Pliny, who described it as found near the mouth of the River Gagas; the hardest, and therefore best jet, is found in this country principally at Whitby and Robin Hood's Bay.

Its use appears to have been known in this country from a remote period; it frequently occurs amongst the relics found in ancient British barrows, and in Roman and Saxon tombs; it is also frequently mentioned in mediæval wills and other documents down to the present day.

In composition it resembles cannel coal, but, it is harder, blacker, and takes a brighter polish, and like coal, consists mainly of hydrogen and carbon. It readily ignites and burns when heated, and on dry distillation yields a quantity of dark oil.

Jet, therefore, does not sound a very promising material for use in glass painting; but in such a case as this, whatever theoretical conclusion one may come to, the only really reliable argument is practical experiment. I therefore decided to see what sort of glass colour one could prepare from jet. For this purpose I obtained a number of specimens from various sources, namely:—

1. A lady's hat-pin, purchased from the street vendors of jet at Whitby.

2. Some specimens of jet collected from the cliffs at Whitby by Dr Andrea.

3. A large piece of unworked jet, obtained from a merchant at Whitby.

4. A brooch and other articles made of jet.

5. Some fragments of Roman jet, from Silchester.

6. A number of jet beads.

I made up some pigment with samples of all these different jets according to the recipe given by Walter Gedde; the result obtained was just as I expected in theory. On putting the glass painted with this "faire black" in the kiln the colour ignited and burnt away like tinder, leaving a slight residue behind which could be readily rubbed off the glass with the finger; jet, as a material for painting on glass, is perfectly useless.

But one may perhaps assume that for "geet" we should read the ashes of jet—the residue left after burning, in the same way as wood ashes were used for making glass. In order to test this I made analyses of these specimens of jet, of which the following may be regarded as typical :—

Moisture	1·56	per cent.
Volatile matter	66·15	"
Coke	29·96	"
	97·67	"
Ash	2·33	"
	100·00	

This ash contained the following :—

Silica, titania, &c.	40·6	per cent.
Iron, alumina and manganese	45·5	"
Lime and magnesia	4·8	"
Alkali	nil.	"
Undetermined	9·1	"
	100·0	

* See, for instance, this *Journal* xxii, p. 80 (Bower, "Whitby Jet and its Manufacture"), and xlix, p. 796 (Seward, "Structure and Origin of Jet.")

This is the analysis of Specimen No. 3, but the others (with the exception of No. 6, which I shall refer to shortly) yielded similar results. No. 5, for example, gave the following figures:—

Moisture	0·02 per cent.
Volatile matter and coke ..	97·85 „
Ash	2·13 „

Now I put it to you—is it probable that a hundredweight of a material of sufficient value to rank as a minor article of jewellery would be destroyed in order to obtain a couple of pounds or so of material for painting on glass, especially when you consider that the material so obtained would be quite useless for this purpose: as you see, it contains no alkali and over 50 per cent. of bases, and would require to fuse it a temperature at which the hardest glass would run like water.

But now I must tell you something—the matter might have ended there—I might have robbed the antiquaries of their beloved jet and left them nothing in its place, only it happened that amongst the specimens of jet I collected from my friends was a necklace of beads supposed to be of finest jet (Specimen No. 6); when I ground up these beads with iron oxide in the same way as the others and put a slip of glass painted with the mixture into the kiln, instead of burning away as I have described it melted and fired into the glass just as an ordinary enamel colour does, so that my glass came out painted "a faire black." Unfortunately, this was a forgery; it was not jet at all. Analysis shewed that it was just an artificial jet made of black glass.

But starting with this material as a basis, and altering the composition somewhat, I could produce a colour which exactly matched the old thirteenth century colour, and passed all the tests I could devise for permanency. Therefore I make the suggestion that the explanation of "geet" is this; that a glass resembling jet in appearance was prepared especially as a flux for painting on glass, which, mixed with the oxides of iron and copper, yielded the fusible pigment with which the mediæval glass was painted.

I admit that I have no direct documentary evidence of this. I have searched the records in vain for the slightest hint as to how or where the substance called geet was obtained, but I can mention several points in support of my contention. In the first place as far back as Roman times we find articles made of black glass and obsidian in imitation of jet. For instance, when I came to examine the fragments of Roman jet from Silchester, that I have referred to as being amongst the specimens examined (Specimen No. 5), I found that only one piece was true jet, the others being composed of a dark green glass with which I could make a glass painter's colour in the same way as with the artificial jet I have just described. The two materials were, however, so identical in appearance, that it was not until I was breaking them up preparatory to analysis that I discovered the difference.

One can readily imagine—of course, this is pure imagination—some mediæval worker making the discovery that a glass made in imitation of jet formed an excellent material for painting on glass, just as I discovered those imitation jet beads. This supposition is the more likely, however, because we have every reason to believe, that in the very early days the crafts of stained glass, enamelling, and the working in gold and precious stones were carried on side by side.

Having once been discovered, what more likely than that the artificial jet should be specially prepared for the glass painters and receive the technical name of "jet." As a parallel case I would mention black lead. As far back as I have been able to trace one finds this form of carbon referred to as though it were a variety of lead. Are we then to imagine that antiquaries of the twenty-sixth century, diving amongst the records of to-day, will argue that it was the custom of the period to cover our firegrates with a film of lead because they read of them being coated with black lead?

Another possible explanation is, that this substance was called jet in the same way as the various coloured glasses were often called by the name of the precious stone they most nearly resembled. For instance we read in Theophilus:—"Tabulas saphiri pretiosas, ac satis utiles in fenestris," Tabulas saphiri, meaning, undoubtedly, sheets of green glass.

Then you may perhaps have noticed in the receipts given by Gedde, the use of the word crystal. To make a grey colour, he says:—"Take iron scales, a little cristall, and sum small quantitie of Ieate." Now no one ever imagines that "cristall" means quartz, or anything else but white glass—why therefore can we not read for "Ieate" black glass?

One other piece of evidence I can offer you, which is this: If you grind up oxide of iron

with a soft white glass, which is a very common way of making glass-painters' colours, the fired glass shows under the microscope a mass of opaque black spots in a colourless matrix.

If, however, you examine mediæval "colour" under the microscope, it appears as a mass of black spots in a deep brown matrix. This also is the appearance presented under the microscope by the colour made up with black glass in the way I have just described; a colour which I have taken the liberty of calling by the name of "geet."

And that, I think, brings me to the end of what I have to say, and I must not detain you longer. Some of you may perhaps question the practical utility of such enquiries as I have discussed to-night; to such I would say—much has been done of late to revive the craft of stained glass, and place it once more in the dignified position it held in mediæval times, but more remains to be done. The bulk of the work must of course rest with the craftsman, on whom lies the responsibility for æsthetic conception. To such a position I cannot aspire; but the maker of materials can perhaps in a humbler way do his part. It is from this point of view that I have endeavoured to throw some light on the technical problems which face the glass painter, feeling that it is a privilege to be able to be of some use in such a cause.

And now I have only left the pleasant duty of acknowledging the help I have received from so many quarters in preparing this paper. I have already alluded to the invaluable assistance of my old friend Mr. Percy Williams, who really did most of the hard work for me; but it is largely due to the kindly encouragement and assistance of Mr. W. H. St. John Hope that I have been enabled to carry out these enquiries, the results of which I now lay before you.

DISCUSSION.

The CHAIRMAN said that a good many things had been explained by Mr. Heaton, which had previously puzzled him; for instance, the source of "scum." He had wasted a great deal of time in persevering ignorance, trying to clean old glass which was covered with the "scum" referred to, when he might just as well have tried to wash away the glass itself. *A propos* of the scum, nobody who had thought the matter out could doubt that the author must be right, and that Winston was quite wrong in his reference to the use of mortar, although, no doubt, the old workmen in times gone by did patch up windows with mortar, and sometimes it was found that old glass had had mortar rubbed across it. But he did not think it would be considered for a moment that they endeavoured to imitate glass, because there was no old glass for them to imitate. He thought Mr. Heaton gave too much honor to certain people in the past when he said they were above doing such unworkmanlike things as "faking." He, himself, had found faked leads in old grilles, which had been put up sufficiently far off to make deception possible. The glass had been painted in imitation of leads. He was much interested to hear of the possibility of extracting the earths and the alkalies from decaying glass, and so getting a skeleton of pure silica. With reference to the decay of glass, the slides shown had been most interesting. Mr. Heaton said that the older the glass the freer it was from decay. That, he thought, was what most of those present felt; and it was decidedly satisfactory to have that corroborated from the more scientific point of view. However, he still would like to know why that was so, and whether the older glass was harder, and got softer as time went on. The concern which artists possessed in the question must be considerable. The decay of glass did add greatly to the quality, and no doubt old glass was so much appreciated because of its decay. Of course it would be the wildest impracticability to suggest that they should make a glass which would decay just enough and no more than was required. What he thought glass-makers ought to devote themselves to was to produce a glass which was not too hard, but which should at the same time give an equivalent to what was obtained by weathering. He did not think that was scientifically impossible. No doubt old glass was made of all kinds of stuff, in a rough and ready way, and with very little scientific precision. Potash and other elements were used. The potash and soda were obtained from all sorts of vegetation, and the sand was of all degrees of impurity and the results were naturally "flukey." But some of the old glass did not decay; and that fact wanted some explanation. It had been found that some glass of a certain period was perfectly rotten, whilst other pieces looked quite new, although when closely examined, they were found to be old. With regard to the painting, he asked why black glass should be more permanent than white? If the flux which was used in it was of common, impure, and dark-coloured glass, that, for all he knew, must be harder than the white or more crystal glass. Was that so? As to the hardness or otherwise of the paint, there could be no doubt, for those who had inspected glass grilles which had been painted could see where the paint had decayed, and could trace the pattern by the preservation of the glass where it had once been covered by the paint. Upon the question of "geet," which was used as an addition to the paint, no doubt Mr. Heaton was

right—it could not have been jet. It might have been jet black glass. The question asked was, What made it black? and the answer had been subsequently given that it was iron and manganese. He was not quite convinced of the use of a special black glass for that purpose; partly, perhaps, because he did not see any necessity for it. He understood the author of the paper to say that where that had been observed through the microscope, it consisted of little specks of black, set in brown. It never occurred to him that the flux the old glass painters used for their paints mattered much. What he thought they were really bent upon obtaining was opacity, the only use of their paint being to stop out the light; and he supposed the copper and iron they used accomplished that purpose. He always thought that the old paint stood the best, because it was fired so hard, and painted more "brutally," and with more decision and emphasis.

Mr. HARRY POWELL, after stating that all interested in the subject of old glass were extremely indebted to the author for the labour he had bestowed on the question, thought Mr. Heaton was also to be thanked for having done away with the theory, which was so common, that the Romans had no blown sheet glass. It was always said that the Romans only used cast glass, but Mr. Heaton had proved most conclusively that they used sheet glass as well. The author had also referred to the interesting point that in the cast glass the bubbles were circular and not elongated. He had recently had occasion to examine the earliest forms of glass, so-called Egyptian glass; and when the little Egyptian vases were examined with the miscroscope, it was found that the bubbles were circular. Dr. Flinders Petrie was, therefore, right in his belief that the old so-called Egyptian vases were not blown, but cast. With regard to Theophilus, his impression was that he was a very intelligent man, but not a glass-maker. Theophilus visited glass works and gave a very interesting account of them, but like journalists, who described modern glass works, while they wrote a good deal of interesting matter, a good portion of it was erroneous. It was also very strange that while Theophilus gave an account of the manufacture of muff glass he ignored circle glass altogether, while his statements with regard to colours were most extraordinary. He did not think it need be supposed that muff glass originated before circle glass, but simply that Theophilus omitted to mention it. If early glass was examined it was rather difficult to tell exactly whether the glass originated as a muff or as a circle. But a good deal of the glass was so thick that it was almost certain to have been a circle glass, and some pieces had unmistakable marks of circles in them. He regretted the author had not investigated the question of the origin of the thirteenth and fourteenth century glass used in windows, because it would have been very interesting to know where the glass came from. It was known that a certain amount of glass came from Chiddingfold, but it was all white glass, there being no record of coloured glass having come from that place. It would be interesting to know whether all the coloured glass came from abroad, or whether some was made in England? With regard to the question of analyses of glass, his experience was that they were about the most fallacious things that existed. Glass was a most difficult substance to analyse, and he did not think he had ever known a glass actually reproduced from analysis. It would be a most valuable asset if details of really accurate analyses could be published. The great difficulty was that a large proportion of the alkaline constituents of the glass seemed to disappear, and a fallacious result was obtained. If a glass-maker attempted to make a glass exactly from an ordinary analysis, it usually would not melt. It had always been a source of immense regret to glass-makers that Winston's papers, giving the results of the many analyses made for him by Dr. Medlack, had never been found; what had become of them was a mystery. The author, in referring to the question of the opacity of old glass, attributed it to the large amount of phosphate of lime. His own experience was that phosphate of lime, by itself, would not produce opacity at all, some other ingredient having to be added to produce that effect. Phosphate of lime helped, but it would not produce opacity by itself. The large amount of magnesia and alumina in the glass were striking, and he thought both of those elements contributed to the horniness of the product. He considered his "horniness" of old glass to be due to physical rather than chemical causes. Mr. Heaton had not referred to one peculiarity of old glass, namely, that colour was very sparingly or hardly at all transmitted through it. It was curious that thirteenth century and early fourteenth century glass would hardly transmit colour at all. Another curious feature, as the Chairman had pointed out, was the smallness of the decay in old glass, some of it being as perfect now as it ever was. He attributed that to the fact that the old makers did not seem to mind in the least about ladling the glass. If it did not suit them they turned it out of the crucible into water, and performed the operation over and over again. He had no doubt that glass, however it might be put together, and however imperfect from the chemical point of view it might have been, if it was constantly ladled into water and re-melted, would at last produce an almost perfect compound. Where old glass had remained almost untouched, he had no doubt it had gone through several processes of re-ladling and re-melting. A year or two ago he was called down to Oxford to advise with regard to a disease very similar to the one to which the author had referred, which occurred at York. It was thought that some of the old fourteenth century glass windows were diseased, and would go to pieces, but, on investigating the matter, it was

found that the old glass was perfectly sound and good, but that some comparatively modern glass, 50 or 60 years old, had gone wrong. There was no doubt that an excess of some substance had been added during its manufacture, and the material had simply crystalised out. The Chairman had raised a question with regard to "geet." He did not think anybody, who had not made glass painters' colour realised how intensely opaque the colour had to be. No ordinary dark coloured glass is dense enough to be used as paint. He thought there was not the slightest doubt that the author of the paper was perfectly right in his contention that geet was merely intensely black glass, coloured very possibly with cobalt. Possibly it was used by the enamellers, who sold it to the glass stainers, and they worked it up in their paint.

Mr. C. W. WHALL, speaking from the point of view of the user of the material, stated that the author used the word "purified" with regard to the difference which existed between old and modern glass, stating that the old makers did not purify the wood ashes, as was done now. Speaking as a painter, he hoped the word "purified" would not be taken in the sense of necessarily adding a perfection to the article, because his feeling was that he wished painters could get their materials a little less pure sometimes. The tendency of the glass maker was to look at things from a scientific point of view, and to think that the more perfectly glass answered to some chemical formula the more perfect it was; but to the painter a good deal of what was called quality arose from the accidents and the imperfections of the material. The same thing occurred with regard to coloured glass. In buying glass from a manufacturer or merchant a particular glass was described as spoiled ruby, or spoiled pink, and he had often felt tempted to say when such were shown to him, "For goodness sake spoil some more." With regard to the question of the restoration of old windows and the proper way to treat them, taking it for granted that the quality which came from age was an added beauty, it was a subject of constant sorrow to see ancient windows treated as if that were a defect. The ordinary processes by which windows were cemented were very rough and drastic, consisting largely in scrubbing; but if old windows were looked upon in the light that they were just as precious as old pictures, nobody would think of employing the methods which were often at present adopted. What should obviously be done was to substitute the process of carefully puttying for the process of scrubbing it with ordinary cement in the way in which new glass was treated.

Mr. E. W. HULME stated that the subject of devitrification attracted the attention of the French artists in the sixteenth century; Palissy noticed that devitrification took place in the churches particularly in the south of France. According to the folklore of the people it was due to the moon's rays. It was particularly noticeable on the south side of the churches; the prevalent south-west winds carried more moisture, and where there was more moisture the glass devitrified sooner. It was quite wrong to think that window glass was made purely with potash at that period, because soda was then being used, and probably had been for some centuries. There was some evidence that there were two distinct schools of glass-makers at the time, one being the Normandy glass and the other the Lorraine glass, and possibly there was a third glass, the Bohemian. Glass painters asked for larger sheets of glass, and for more pellucid glass, and for that purpose soda was used in place of potash, and flint in place of the aluminiferous clay sands which were being used in other parts. In reply to Mr. Powell's questions as to where the window glass used in England came from, he thought most of it came from abroad. At Chiddingfold, green glass was made, but it was pretty certain they did not make a coloured glass. There was no reliable evidence that glass was made in England elsewhere than at Chiddingfold before 1563. He was aware that it had been stated that there was a school of Dutch glass-makers in Southwark in the reigns of Henry VII. and Henry VIII., who were credited with some of the most magnificent specimens of glass in this or any other country; but he had recently examined the documents upon which that statement was made, and had come across a document in which it was openly stated that the foreign glazier, Peter Nicholson, was not only using foreign glass, but actually bringing the glass, ready wrought, into the country. The Company of London glaziers complained, and they took the individual before the Star Chamber for breaking the laws of the realm, as it was a statutory offence to introduce ready wrought glass. That Southwark glazier employed both Dutch and English workmen, but it was very clear that nearly the whole of his glass came from abroad. The analyses given by Mr. Heaton were of very great interest because, he did not think he had ever seen it stated that phosphorus existed in so large a proportion in mediæval glass. In 1896, a very valuable work had been published by M. Appert, a great French writer, chemist, and glass manufacturer, on the subject of the composition of the glass of the old stained-glass windows. His view was that the resistance to devitrification of glass was due partly to the use of potash, but mainly to the use of alumina at that period. He advised those who were interested in the subject to read the work, although it was rather difficult to obtain as it was out of print.

Mr. JOSEPH LOVIBOND said that his interest was restricted to the relation of colour between the glass of the old windows and the glass of modern manufacture. He desired to ask the author if he had been able to trace any relation between the analyses of the two glasses and their colour variations? The more

refractory elements had increased in proportion, while the more soluble elements had decreased in proportion, which must be a very important effect upon the colour-evidence of the glass itself. A second cause which had been most ably treated in the paper was the alteration by surface erosion. In all the old glass he had examined there had been a very much wider range of surface erosion than had been shown by Mr. Heaton. It was quite manifest that the nature of the surface erosion must materially affect the colour developed. For instance, in some of the cases there were evidences of certain pits which were so close together as to form almost a regular surface. They acted as a disperser of light, and consequently destroyed the colour effects of the glass itself. The crystals might act as refractors, or even as condensers, and so alter the nature of the colour. He had been particularly interested in the effect the different changes had on the nature of the colour developed, although the question was so intricate and complicated that he was quite unable to throw any light upon the subject.

Mr. Walter Reid enquired whether the author had noticed any essential difference between the corrosion on the exterior compared with the interior surface of the glass, because that would at once throw some light upon the probable chemical cause of the erosion of glass. The circular form that was noticed, might possibly be due to some slight imperfections in the colour upon the glass, and, in that case, the corrosion would go on from the point outwards, and become circular. That was noticed in other substances, for instance, in iron. If once the coating of paint became injured pitting took place, and exactly the same structure was formed. When a metal of any kind was dissolved in acid the pitting which had been so clearly described by the author took place. There was no doubt whatever, from the slides that had been shown, that the pitting in some instances was due to the expansion of small bodies in the body of the glass, and if it were possible to get a microscope slide showing a section through one of the cavities, it would throw a good deal of light on the subject. It was highly probable that the corrosion was due to the solvent action of the carbonic acid of the atmosphere, the more so because in the earth, where the air was almost continually saturated with carbonic acid, the corrosion was so much quicker than it was when it was exposed only to the air. He thought it might possibly be due to the more continuous action of carbonic acid underground than when it was exposed to the atmosphere. It was also quite possible that in the case of the windows there was an electrolytic action. The glass was a non-conductor; it was surrounded by two or three metals, because there were soldered joints in many cases, and it was possible a slight electrolytic action was set up, which, after going on for a century or two, led to serious results upon the glass. With regard to the question of colour, it seemed to him that none of the old glass had a white base at all; it always had a greenish base. If a piece of common window glass were placed behind a piece of bright modern glass an effect similar to the older glass was obtained. Probably the sand that was used in the glass-making was very different from the qualities that were utilised now-a-days.

Mr. James Powell thought the remarks Mr. Whall had used with regard to the repairing of old glass were worthy of a good deal of consideration. He had lately been repairing some very beautiful fourteenth century glass, and in doing so he had not used a single piece of modern painting. A great deal of mischief had been done to old glass by putting in new pieces of coloured glass, contrasting with the old, and also by trying to imitate in paint some of the work of the early masters. He thought it was very important that the old work should be put together as soundly as possible in good lead, but that no new pieces of painted glass, and no new pieces of colour, should be added to it.

Mr. Philip Newman observed that he had severa samples of old glass with a pitting on the outside, but no indication of similar decay on the inside; which seemed to point to the fact that some atmospheric condition, which did not exist inside the building, was responsible for that condition rather than chemical disintegration or a change in the nature of the glass itself. A popular belief was held by those in favour of the external influence theory that a modern window had only to be kept long enough and it would present the same charming artistic effects as old fourteenth century windows. It would be unfortunate if that idea was done away with, because it would rob the donors of stained glass windows of much of the benefit which they thought they would confer on posterity.

Mr. Heaton, in reply to the Chairman's remarks with regard to "faking" of glass, said that in his paper he stated that credit must be given to mediæval glass painters for being ignorant of such practices; but nevertheless he was quite sure that, if it had occurred to them to do such things, they were quite as capable of carrying them out as people living at the present time. Without making a complete series of analyses of specimens, it was very difficult to answer the question why the older glass was freer from decay; that was the only way to answer the point satisfactorily. The Chairman had referred to the use of black glass for the flux. If the glass was coloured before the pigment was mixed with it, there was always a certain amount of opacity in it; whereas when the pigment was merely mixed with a colourless glass, in the finest lines the pigments tended

to get lost in the flux. He quite agreed with Mr. Powell, that Theophilus was not to be entirely relied upon. He should have hesitated to say so himself, but as Mr. Powell had led the way he had no hesitation in following his lead. He had always been told that spun glass, to the omission of which Mr. Powell referred, was referred to in the lost chapters of Theophilus; in fact, whenever anybody got into difficulties with Theophilus they always took refuge in the lost chapter, There was no doubt that spun glass was frequently found in early work; he has seen it himself in many cases. With regard to the question of the accuracy of the analyses, he quite agreed with Mr. Powell that analyses of glass were very often of doubtful utility, but the gentleman who made these exhibited was so skilled in undertaking complex silicate analyses that he was confident of their absolute accuracy. As regards these analyses however he would greatly appreciate it if any of his hearers would favour him by reading the description of the process employed given in the paper, and sending him any suggestion that occurred to them with a view to future work. He did not think the term, "opacity," was a correct expression to use in connection with mediæval glass; he would call it a slight opalescence, which, it seemed to him, was very readily explained by the presence of phosphorus in the glass. He had heard the statement made several times lately, that colour was not transmitted by old glass. It seemed reasonable to suppose that coloured glass ought to transmit coloured light whether it was old or new; but he had not made any experiments on the point. Mr. Whall had referred to the purification of the wood ashes. Wood ashes were not used now-a-days, in fact potash was never used in sheet glass. He did not know why that was so, and thought it was a great mistake. He entirely agreed with Mr. Whall's remarks with regard to the restoration of old glass, and, but for the length of his paper, would have referred to it there. M. Appert's work, which Mr. Hulme mentioned, was exceedingly interesting, but, so far as he had studied it, he did not entirely agree with the conclusions arrived at. It was, however, rather presumptuous to differ from M. Appert without thoroughly investigating the matter, which he shortly hoped to do. Mr. Reid had referred to the value of making microscopic sections showing the pitting in process of formation; and he hoped to be able to make some sections as soon as an opportunity presented itself. He agreed with Mr. Reid as to the possibility of pitting not always being due to the same cause. In the pitting, he (the author) showed the action was going on underneath a surface which was perfectly bright and free from corrosion, so he did not see how it could be a case of corrosion. In conclusion he would like to take the opportunity of asking glass painters to remember him when they had old glass passing through their hands and give him the opportunity of examining it.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Heaton for his interesting paper, and the meeting terminated.

NOTES ON INDIAN RAILWAY SYSTEMS.*

II.

The Bengal Nagpur Railway System.—Of this system of 1,990 odd miles of line, 1,697 miles are 5 ft. 6 in. gauge, the balance consisting of light railways of 2 ft. 6 in. gauge acting as feeders. This is one of the largest of the, as yet, unabsorbed private lines, the State guaranteeing the interest on the authorised capital outlay, at the rate of 4 per cent. per annum.

The Government has the right to determine the contract at the end of December, 1913, by giving 12 months previous notice, or, similarly, at the end of any succeeding tenth year. At the termination of the contract, the railway and all its belongings are to be handed over to the Government which will, on its part, repay the amount at par of the subscribed share capital of the company. It seems exceedingly probable that the Government will exercise its option on the first possible occasion, as the conditions of the guarantee have involved heavy losses to the State, a profit only having been secured four times since 1879. The revenue per mile of track is distinctly low. In 1904 (the best year recorded) this only amounted to 210 rupees. The line is certainly worked under economical conditions, as during the past six years the ratio of expenses to earnings has fluctuated between 40·56 and 54·63 per cent., the figure for 1904 being 48·97 per cent.

The permanent way is laid with 85 and 75 lb. flat-footed steel rails, with cast-iron pot sleepers, and transverse steel sleepers, a good stone ballast being used throughout. The ruling gradients vary between 1 in 125 and 1 in 200.

Financially, the year 1904 gave a net gain to the State of slightly over £3,000, as against a loss four times as great in the preceding year. The net earnings were 3·67 per cent. of the capital outlay.

The locomotive equipment consisted of 57 passenger engines and 174 goods engines. The total mileage run per day was 74 miles for passenger engines and 53 miles for goods engines. Per annum, the respective mileage is 27,225 and 19,276. The average ton mileage hauled per engine was 7,186,000 tons. The passenger rolling-stock consisted of 911 vehicles, the average daily mileage being 113.

The goods-vehicles numbered 7,148 of all sorts, their annual and daily mileages per vehicle being

* Abstracted from the Indian Government Railway Returns.

14,112 and 38 miles. The average profit earned per goods-vehicle mile was 15·65 (pies or 1,304 pence).

The Bengal and North-Western System.—Leaving certain of the broad gauge systems undescribed in order to analyse briefly the four chief metre gauge lines within the limits of the present article, the first of the latter is the Bengal and North-Western. Since 1882, when the first portions were sanctioned, some 870·80 miles have been opened for traffic, and 148 miles are under construction. By way of Government aid, land was provided free of charge. The various contracts between the railway company and the Government terminate by effluxion of time on December 31st, 1981, when the line and equipment becomes Government property on payment for rolling stock, moving machinery, stores, &c. The Government has, however, power to determine the contract on either December 31st, 1912, or of December 31st, 1932, on one year's previous notification of intention to purchase, at twenty-five times the average net earnings (up to but not exceeding 6 per cent. per annum on the share capital) for the five years preceding the purchase. The permanent way is laid with 50 lb. and 41¼ lb. steel rails, on sal sleepers; broken brick ballast is used. The sharpest curve has a radius of 900 feet, with a length of 2,000 feet. The ruling gradient is 1 in 300. The revenue per mile per week reached 168 rupees in 1904, the previous highest revenue being 161 rupees per week in 1903. The system is undoubtedly worked economically, as the ratio of expenses to earning in 1904 was 39·68. The net earnings were equal to 6·90 per cent. on the capital outlay. The traffic is handled by 225 locomotlves, of which only 20 are classed as for passenger service. The yearly mileage worked out as follows: 23,993 and 18,029 miles for passenger and goods services respectively, the daily mileage being 65 and 49. The ton mileage hauled per engine in 1904 was 4,279,000. Passenger vehicles numbered 942, the average mileage run by each being 140. Goods vehicles of all classes amounted to 5,711, the average daily mileage being 32. The average earnings per goods-vehicle mile were 21·76 pies (or 1,813 pence).

The Burma Railways System.—A particular feature in connection with this metre gauge system is that the Burma Railway Company was formed in 1896 to take over the existing State railways in Burma—which then had a length of 886 miles—and to extend these by the construction of other lines in particular—one from Mandalay to Kunlong. The terms of contract provide for a Government guarantee of interest at the rate of 2½ per cent. on the share capital. Land was also provided free of charge. The Government has the power to determine the contract at six months' notice if the company fails to perform its obligations, or in case of gross mismanagement, or if worked at a loss during three consecutive half-years. Alternately, the Government may also determine the contract at twelve months' notice on the 31st December, 1921, or at the end of any succeeding tenth year. In any event, if the contract is determined, the Government repays the share capital at its par value. After deducting working expenses, paying a fee for supervision, and interest on debenture and share capital, the balance of the annual profits is divisible in the proportion of four-fifths to the State and one-fifth to the company. During the last four years the company's share of the net earnings has varied between £25,800 and £39,500.

The working expenses have borne a fairly high ratio to gross earnings, the lowest value during the four years being 56·49 to 100 in 1904. The earnings per mile per week during 1904 were 216 rupees. The total mileage open at the end of that year was 1,340 miles, while 187 miles were under construction.

There is no special feature in the permanent way, 50 lb. rails being laid where the traffic is heavy, and 41¼ lb. rails where it is light. The sleepers are of teak and other indigenous timbers. Shingle and broken stone ballast are used. The ruling gradient on the main line is 1 in 200, but other severe gradients of 1 in 25, 1 in 60, 1 in 100, and 1 in 150, are to be found on the branch lines. The sharpest curves in the main line have (*a*) a radius of 573 feet with a length of 1,100 feet, and (*b*) a radius of 1,146 feet with a length of 2,900 feet. Sharper curves are to be found on the branch lines.

The traffic is worked by 236 eagines, 28 of which are classified as for passenger service. The average annual mileage of the passenger engines in 1904 was 30,228, and of the goods engines 17,612. The daily mileages worked out at 83 and 48 respectively. The passenger vehicles numbered 993. The average daily mileage per vehicle was 91. Goods-vehicles for dealing with the heavy traffic in agricultural produce amounted to 4,985. The daily mileage was 28, and the freight ton mileage was 41,000. The average profit per goods-vehicle mile was 9·5 pies (or practically 0·8 pence).

The Rajputana-Malwa Railway.—This long metre gauge line is classified in the Indian Government Railway Returns as a component part of the Bombay, Baroda and Central India Railway system. But the B.B. & C.I. Railway proper is a broad gauge line having a length of 504 miles, while the Rajputana-Malwa line has a length of 1,682 miles. The B.B. & C.I. Railway Company has worked this narrow gauge line since 1885, by an arrangement with the Government, whereby the working expenses of the entire system are pooled and divided between the component parts of the system in proportion to the gross earnings of each. The net earnings thus arrived at of the Rajputana-Malwa 3 feet 3⅜ inch line are paid in full to the Government. The company has the right to vary the fares within certain prescribed maxima and

The Rajputana-Malwa line itself dates back to 1870, when the Delhi-Rewari section of 51·25 miles in length was opened. The main line type of con-

struction at first adopted provided 36 and 40 lb. flat-footed iron rails on transverse deodar and creosoted pine sleepers. The 36 lb. rails gave place to 41½ lb. flat-footed steel rails, and these in turn to 50 lb. flat-footed steel rails, the half round pine sleepers being replaced by deodar sleepers. For ballast, stone, kunkur and sand are used, with a length of hard quartz some 30 miles in length. The sharpest curves have a radius of 600 feet; the ruling gradient is 1 in 150, with some short lengths of 1 in 40. The rolling-stock used consisted of 145 passenger engines, and 290 engines used for goods and mixed traffic. The respective average annual mileages are 22,617 and 14,911, or 62 and 41 per day. The passenger rolling-stock amounts to 1,684 vehicles of all classes, the average daily mileage of which is 106. The total number of vehicles used for goods traffic was 7,477, the average daily mileage being 39, while the annual freight-ton-mileage was 49,000. The average profit per goods vehicle mile was 14·66 pies (or 1·22 pence).

The Southern Mahratta Railway System.—The first contract between the Southern Mahratta Railway Company and the Government was signed in June, 1882, and by the end of 1884 the mileage open for traffic amounted to 214 miles. Within a further space of six years the system was completed, the total length of the Southern Mahratta Railway proper being 1,042. Subsidiary narrow gauge lines embraced by this system cover 601 miles of open line and 77 miles under construction. Government aid was afforded by a guaranteed rate of interest of 3½ per cent. in sterling on the approved share capital. Up to December 31st, 1890, an additional one-half per cent. was guaranteed. Under present working conditions three-fourths of the net receipts are paid to the Government, and one-fourth to the company. The contract is current for a period of 50 years, but the Government has the power to determine the contract after 25, 35, or 45 years (*i.e.* in 1907, 1917, or 1927) on one year's previous notice, or on six months if the company fails to carry out its obligations or is worked. Upon determination of the contract either by notice or by effluxion of time, the Government repays the share value of the company at par.

Financially the line is anything but a success. The earnings per mile of line per week were only 135 rupees in 1894, while the expenses were 63·29 per cent. of the gross earnings. The net earnings only worked out at 2·72 of the capital outlay, and the loss to the State amounted to nearly £135,000 sterling.

The permanent way presents no special features of interest. 44½ and 62 lb. flat-footed steel rails are used with steels and native wood sleepers. The ruling gradient is 1 in 100 except for three miles of 1 in 40.

The total number of locomotives in use on this line is 238, of which only 30 are definitely classed as allocated to passenger service. The average annual and daily goods engine mileages are 16,170 and 44, while the average annual and daily passenger engine mileages are 22,263 and 61. The number of passenger vehicles of all classes is 1,055, the average mileage run by each being 74. Goods-vehicles of all classes amounted to 4,861, the average daily mileage of each being 32. The average profit per goods vehicle mile is only 7·72 pies (or 0·64 pence).

RECENT DEVELOPMENTS IN ECONOMIC BOTANY.

In these days of progress and developments in all branches of science and manufactures, it is curious and interesting to note the numerous side lines and ramifications, not only amongst new vegetable products, but also very largely amongst those that in years gone by have had a steady existence for some one particular use, and these remarks apply equally to articles of food, medicine, or manufacture. Thus for instance, the trade in foreign and Colonial fruits was, until quite recently, confined chiefly to oranges, lemons and bananas, with occasionally a few mangoes, granadillas and Avocado pears.

The greatest development in any of these has been in the banana; the enormous increase in the shipments of which is familiar to everyone. There is no question about this fruit having taken hold of the popular taste, and those who observe this evidently think that the time has come when the banana should be considered in some other light than that of a favourite fruit, hence we have already seen that "Bananina," or banana meal, has been brought forward as a nutritious and easily digested article of food, and as an outcome of this another alimentary product is now announced, consisting of the pulp of the banana ground to flour and mixed with triturated cocoa (*Theobroma*) seeds, milk powder, and extract of malt. The process of manufacture consists in removing the peel of the mature banana fruit, and extracting from the peel its essential oil, drying the banana pulp and granulating and grinding it to powder, volatilising the essential oil from the peel, adding it to the banana flour and mixing with it a proportion of dried milk powder and pure extract of malt, and also the paste prepared from the cocoa seeds, and finally adding a sufficient quantity of sugar for flavouring. This composition is said to possess all the essential elements of a complete food in a concentrated form, namely, albuminous matters or proteids, fatty substances and hydrocarbons. Here, then, is a new outcome of the banana trade.

With regard to dried fruits it does not seem many years ago that raisins, currants, and a few prunes were the sum total of the culinary fruits that housewives had to fall back upon in the winter when fresh fruits were unobtainable, and these even were considered almost essentially Christmas fruits, but at the present time not only are these to be obtained at all times of the year, but in addition to them are the English grown bottled or canned gooseberries, plums and

other well known products of our fruit gardens which, though lacking much of the flavour of the freshly gathered fruits are by no means a bad substitute. A more recent addition, however, to our winter fruit supplies are the dried peaches, plums and pears, which are full of flavour and are excellent either stewed or in tarts; the only drawback is that they are so completely desiccated, that they require steeping in water for some 24 to 36 hours before using.

The advance made within the last 30 years in the use of cocoa as a beverage is very remarkable, and is, perhaps, due to a great extent to the persistent advertising of the leading firms engaged in its preparation. Whatever the cause, the result is satisfactory, seeing that in cocoa we have a wholesome and nutritious drink; but this is not all, for its applications in confectionery at the present time, in the form of chocolate creams and other similar delicacies, are so multifarious and extensive as to add considerably to the imports of this well known seed. Again, with the cocoa nut, or coker nut, as it is sometimes spelt to distinguish it from the *Theobroma*; many additional uses have been found in recent years both for the kernel of this nut, as well as for the oil in which it abounds. Though at one time the kernel was used almost exclusively in biscuit-making, its more recent developments have been in the direction of sweetmeats, for which it is now very largely applied. The oil, obtained by expression, was not many years since used almost exclusively in the candle and soap factories. Now, however, we find it used for culinary purposes as a substitute for lard or cooking butter under the names of "Nucoline" or "Vejsu" (a corruption of vegetable suet). In consequence of these extended uses, an increased demand has arisen for the oil, hence the rise in price of one of the materials in soap making upon which the makers base their advance in the price of soap itself.

Turning from food products to articles of manufacture, as might be expected in consequence of the widespread application of motor-power to road vehicles, and the development of electricity, we find the greatest amount of attention has been, and is still being given to rubber, both with regard to the question of supply as well as to that of quality, for notwithstanding that many new sources of rubber have of late years been brought to notice, none has been discovered that at all equals, or perhaps even approaches in quality and durability the old and well-known Para, which at the present time is worth about 5s. 6d. per lb. It has been stated that every motor car requires about £50 worth of rubber a year, and every motor 'bus £200 worth. Further, that the world's consumption now amounts to about 60,000 tons, and that by the end of the present year, at a rough estimate, the motor 'bus industry would consume two and a-half million pounds worth annually. To meet such a constantly increasing demand much attention has been given by public and private bodies to the extension of plantations in every country where it has been considered the particular plant would grow. This is the only way of meeting an ever-pressing emergency, and though the Para tree is a comparatively slow grower as compared with some of the other kinds, its cultivation should be systematically carried on where it is known that it will flourish.

With regard to vegetable fibres, in which field an enormous amount of energy has been shown in introducing new plants for trial, not so much for supplanting or substituting the old and well-tried flax, cotton, and hemp, but rather as additional to them, to meet the great and increasing demands for fibres for textile purposes, as well as for ropes and cordage, it may be well to note that out of the great number of fibrous plants that have been introduced during the last forty or fifty years, none can approach in the strength and durability of its fibres the plants already mentioned, namely, flax, cotton, and hemp. Jute, though it has become such an enormous article of import, and is now so extensively used in carpet and mat weaving, as well as for the cheaper kinds of cordage, lacks durability. Perhaps the most valuable of all the substitutes for the older vegetable fibres is rhea, or ramie, which, after a period of ups and downs, extending over more than half a century, during which time it has attracted much attention at the several international and trade exhibitions both at home and abroad, seems now to have really become established, and acknowledged in the manufacture of fabrics familiar to us by reason of attractive advertisements; and, though numerous experiments have been made with satisfactory results in weaving it into tapestries for curtains and furniture coverings, as well as for mixing with silk, or even alone as a substitute for silk, on account of its soft, glossy nature, its chief use at the present time seems to be for underclothing, for which it has been strongly recommended as possessing remarkable hygienic properties, absorbing and diffusing perspiration, and so preventing chill, besides preserving a normal temperature under circumstances which would otherwise produce exceptional heat. Its soft, silky character is said to make it peculiarly adaptable for delicate skins, and besides all this it is absolutely unshrinkable. For ladies' dress materials also, ramie fibre is now being made in all the fashionable colours. Moreover, a silk-like thread of extreme lustre, dyed in all the delicate tints now so general, has become very popular in art embroidery to which it lends itself as much for its ease in working as for its cheapness,—the source of this is without doubt the well-known ramie. Another entirely new application of this fibre is for the manufacture of incandescent gas mantles, for which purpose it is claimed to have many advantages over any substance hitherto used, the chief of which are greater strength, and in consequence the longer life of the mantle, greater illuminating power, and considerably less cost.

Whether all that has been said of the advantages of ramie for these new applications will be confirmed, experience alone will prove, but the writer of this article is able to attest, from his own knowledge, to the strength and durability of woven fabrics of nearly a quarter of a century back, so that with a fibre of such acknowledged capabilities it is much to be hoped that at last it has come to take a permanent lace in British commerce.

THE TREND OF TRADE.

The statistical Abstract for the principal and other foreign countries in each year from 1894 to 1903-4 has just been issued, and contains an immense amount of information respecting the trade of the world and its trend. The tables in the Abstract are in practically the same form as in previous issues, except that those showing the principal exports and imports of France, Germany, and the United States, have been considerably amplified and amended. Tables have also been added dealing with the import and export trade of Brazil, and with the production and consumption of cotton in the United States. The figures dealing with the shipping of the world show that the United Kingdom maintains its decisive supremacy, although proportionately other countries have improved their position. Thus, if we take the total tonnage of British sailing and steam vessels cleared from the ports of the United Kingdom and Germany respectively in the years 1894 and 1904, it will be found that the British tonnage cleared rose from 26,682,883 tons in 1894 to 31,893,297 tons in 1904, whereas the total German tonnage, taking the same years, rose from 5,104,348 tons to 8,750,219 tons. In 1894, the German tonnage cleared was considerably less than one-fifth of the British; in 1904 it was considerably more than one-fourth. These figures in both cases apply to vessels with cargoes only. In the case of the United States, there has been only a very slight proportional rise. In 1894 the American clearances with cargoes amounted to 3,000,747 tons, and in 1904 they had only increased to 3,308,430 tons.

The statistics of emigration show that in the case of nearly all European countries it continues to grow, although not always in proportion to the increase in population. This is most noticeable in Germany. Whilst births in that country have increased from 1,143,044 in 1894, to 1,264,534 in 1904, the total number of emigrants of German nationality, which in 1902 was 32,098, in 1905 was only 28,075. Most of the German emigrants go to the United States, and out of the total of 28,075, which left Germany in 1905, 26,005 went to America; Brazil, by the way, where there is a German colony, only getting 333. In proportion to population, the emigration from Italy is far larger than from any other country, and shows rapid increase in recent years. In 1898 the total emigration from that country was 139,187, las year it had increased to 479,349. The larger proportion still goes to the United States. In 1898 the number was only 56,703, whilst last year it had risen to 316,797. Next to the United States the larger number go to the Argentine, Uruguay, and Paraguay, the numbers rising from 36,793 to 88,840. The Italian emigration to Brazil has fallen from 38,659 to 30,079, but it is worthy of note that whilst much is said about the German colony in Brazil, Italian emigration to that country is enormously in excess of German. Emigration from Norway has risen from 6,207 in 1895, to 22,332 in 1904, nine-tenths of it going to the United States. The figures for Sweden are much the same, having risen from 9,678 in 1894 to 35,975 in 1903, and of this latter number, no less than 35,439 went to the United States, 325 of the remainder going to Canada. And so with Denmark, where the increase has been from 3,607 in 1895 to 9,034 in 1904, 8,405 going to the United States in the latter year.

The total value of imports and exports of merchandise into and from the respective countries shows, in nearly all cases, large expansion, but in none so large as in the United Kingdom. In 1894, the general imports were valued at £408,345,000; in 1904 they had risen to £551,039,000. Germany comes next with £210,250,000 in 1894, and £336,045,000 in 1904; the United States increasing from £136,457,000 to 206,476,000, but in general exports the United States takes the lead, having risen from £185,863,000 to £304,339,000, Germany coming next with an increase from £162,995,000 to £278,260,000. Perhaps the most striking increase is to be found in mining products. In 1880 the United Kingdom was far ahead of all other countries in the production of coal, the product for the year being 146,060,000 tons, as against 67,998,000 tons for the United States, and 46,974,000 tons for Germany. Last year the figures were very different. The United States produced nearly 90,000,000 tons of coal more than the United Kingdom, and Germany had increased her product to 121,298,000. It is much the same with iron ore as the following figures show:—

	1880.		1905.	
	Coal.	Iron.	Coal.	Iron.
	Tons.	Tons.	Tons.	Tons.
United States	67,998,000	7,120,000	328,102,000	44,054,000
Germany ...	46,974,000	7,239,000	121,298,000	23,444,000
United Kingdom	146,060,000	14,591,000	236,129,000	18,026,000

The cotton production of the United States has somewhat more than doubled since 1885, and its destination has altered considerably. In the earlier year 68·96 per cent. of the domestic product was exported; in 1905 only 61·55, and whilst in 1885 Great Britain took 1,209,917,044 lbs., against 234,493,533 lbs. taken by Germany, in 1905 the import to the United Kingdom had only increased to 1,983,626,888 lbs., whilst that to Germany had

risen to 1,005,839,498 lbs. France had again increased her import from 180,730,787 lbs. to 409,151,840 lbs., and Belgium had nearly doubled her import, whilst that of Italy rose from 29,563,180 lbs. to 267,367,731 lbs. On the other hand, the United States retained for domestic consumption in 1905 2,689,422,828 lbs., as against 2,689,432,828 lbs. in 1905.

GOLD MINING IN WESTERN AUSTRALIA.

Gold is still to be found in abundance in Western Australia, and constitutes the chief source of wealth of that State of the Commonwealth. Since 1891, when practically the first discovery was made, there has been a constantly increasing output, with the exception of 1900, 1904, and 1905, when the yield fell slightly below that of preceding years. Prior to 1898 the entire production amounted approximately to £4,800,000, but in that year work was begun in earnest, with the result that in the succeeding twelve months over £4,000,000 was taken out. In 1901 the sterling value of the gold mines was £6,720,000; in 1902, £7,609,000; in 1903, £8,336,000; in 1904, £8,129,000; in 1905, £7,819,000, and up to May 31, 1906, the yield amounted to £3,044,000. For purposes of comparison, and to show the position which Western Australia occupies in the world as a gold-producing State, the figures of 1904, showing the yield in ounces in Western Australia, the United States, and the Transvaal are given:—Western Australia, 1,983,000 ounces; United States, 4,090,000; and the Transvaal, 3,773,000 ounces. For several years the problem of a water supply for the gold fields was most difficult to solve, for in Western Australia, about 400 miles from Perth, the capital, there are no rivers, few natural supplies of surface water, and the rainfall is light. The vital importance of overcoming this difficulty was recognised by the State, and some idea of the magnitude of the undertaking may be formed by the cost of the construction, which amounted to over £3,000,000. In 1896, the approval of the Legislature was obtained to an expenditure for the provision of a supply of 5,000,000 gallons of water a day. The work was energetically pushed on, and brought to a successful completion in 1903. The supply, which is now regarded as adequate to the demands of the gold fields, is pumped three hundred and fifty-one miles. Fully 18,000 men are engaged in mining, and the wages paid are sufficiently high to induce first-class miners to remain permanently employed. In the gold fields the value of mining machinery in use amounts approximately to £4,000,000, and there have been erected about four thousand stamps. These figures show conclusively the splendid industry that has been built up, and everything now points to a continuance of the prosperous conditions.

ARTS AND CRAFTS.

Wall-papers.—To say that of recent years wall-papers have rather "gone to the wall," might perhaps lead to some misunderstanding. Still, the expression does suggest the kind of feeling which has come over people with regard to the trade. For some reason or other, wall-papers, or at any rate printed wall-papers, do not hold altogether the position they did. The satisfactoriness of the plain colours that can be got by means of distempering directly on to the walls has had, perhaps, something to do with this, and the practice of using painted or dyed canvas has, no doubt, further contributed to it. Still, the initial expense of painted canvas prevents it from being very largely used, and there is always to the ordinary man a certain nakedness about a distempered wall. At any rate, from no matter what cause, the fashion has of recent years very much changed, and in place of a filling paper in a bold design, coming straight up to the cornice or finished off with a more or less insignificant border, we see more often nowadays a plain wall or one bearing only a powdered or striped pattern, crowned by a frieze of at least a foot in depth and very important in design. Again, perfectly plain ingrain, or even lining, paper is quite often used now, to say nothing of brown paper. It may well be that this is a more or less unconscious protest against the sometimes very ugly lines which characterised a good deal of the wall-paper design of some years back.

Be that as it may, the idea seems to be abroad that there is something rather contemptible about a wall-paper; and so it comes to pass that at the present time the best efforts of the manufacturers are directed to producing effects of some other material. It does not appear to matter much what material is imitated so long as the thing is an imitation. The practice of counterfeiting tiles in bath-room papers is, of course, a very old one, and one, moreover, that explains itself; it is less apparent why people, especially in cities, should wish to pretend that their walls are covered with muslin curtains or with stuffs of various kinds. But this is apparently their desire, and all sorts of ingenious devices are employed to meet it. Some papers are printed with irregular vertical lines, giving them the appearance of rather uneven linen; others are on a slightly indented or impressed paper, which is crossed at intervals by chequer lines, and look, at a distance, like a rather coarse woollen or sacking material, on which, perhaps, a sprig or other small diaper-pattern is printed or woven at intervals. At times, something rather bolder is attempted, and, by a cunning device, a pattern is so printed that until one is near enough to touch it, it is difficult to believe that it is not in gesso or some other kind of relief. Again, advantage is taken of the rather uneven surface of some of the thicker kinds of paper to produce in ordinary distemper colour something which is to all appearances flock.

The patterns of any importance which are being brought out are, for the most part, early-Victorian chintz patterns adorned with large bunches of roses

or other natural flowers, and large damask patterns. The designs of these last are, in the main, copies or adaptations of old Italian silks, and are more often than not produced in a single colour on a satin-paper ground.

Cretonne and Wall-paper Design.—There is generally a certain similarity in the designs being used for wallpapers and cretonnes. Some people like the curtains and chaircovers, in their bedrooms at least, to be so much alike that they may be said to match—and, apart from this, there is always a demand for cretonnes "to go with" wallpapers and *vice versa.* It is true that the stripes which are still so popular in wall-papers have gone out of fashion for cretonnes, and dotted diaper patterns are now mainly used for casement curtains; so that, whilst in the case of wall-papers there is a large proportion of work being done which can hardly be dignified with the name of "design," matters are somewhat better with regard to cretonnes. Still, in both materials, there is a great deal being produced in the would-be naturalistic style of the mid-Victorian period. The proportion of pattern to ground is also very much the same.

Time was when most wall-papers were printed in "all-over" patterns, and the ground of cretonnes was as well covered as in the old-fashioned chintzes. We have long since changed all that, and at the present time the distinguishing characteristic of the wall-paper and cretonne designs is openness. A design (except it be a simple two-colour reversible) seems to have no chance of selling unless it shows plenty of ground space. No one, apparently, will look at designs of the old-fashioned all-over type, or at anything which, by the wildest stretch of imagination, could be called "crowded." Oddly enough, this demand for plenty of ground space seems to be more pronounced with regard to wall-paper and cretonne than to almost any other kind of material—and these happen both of them to be of such a quality that the ground is not really worth showing. There is no intrinsic beauty in the surface of cotton cloth or of the kind of paper usually used for wall decoration—and it is rather extraordinary that fashion should demand that so much of it should be shown. We can all understand and appreciate the beauty of plain surfaces in linen or silk damask, in pile velvet and other such fabrics. The demand for them in materials which are in themselves of no particular beauty, and might almost be called "makeshifts," is difficult for the ordinary mind to understand. An open pattern may be, and often is, graceful in a way peculiarly its own, and designs of this kind have much to commend them. They are, indeed sometimes, more reposeful than those which are fuller of detail; but, if they are to be really effective, they demand a ground which is in itself of a texture pleasant to look upon.

South African Arts and Crafts.—We are accustomed to look upon the colonies, and more especially the newer amongst them, as rather hopelessly outside the art movements of the day; and the idea of colonial arts and crafts is apt to bring a rather contemptuous smile to the lips of the English critic and connoisseur. This is not to be wondered at, for everyone must have seen some truly appalling colonial products labelled Art (with a very large "A"), and exhibited as something really remarkable, which would in England only pass muster at the most ordinary of bazaars. This state of things, moreover, is very evidently not a thing of the past, and it is not merely insular British pride which makes us still look askance at the efforts of Greater Britain towards art, whether pure or applied. It is, therefore, with a distinct feeling of astonishment, not to say relief, that we notice the signs of better things which are to be seen at the South African Products Exhibition. It is not that there is anything exhibited which is in itself very wonderful, or even perhaps, if judged by a high standard, very beautiful—but there are exhibits which show taste and appreciation of the beautiful, more especially in colour, which we should hardly have expected to find there.

First and foremost, from this point of view comes the little show of the Boer Home Industries and Aid Society. It consists almost entirely of tapestries and rugs woven in many cases from angora wool with a cotton or jute warp (which last is sometimes imported and sometimes home grown). Work of this kind, done as it is largely in schools quite recently founded, with a view to finding employment in their own homes for Boer women and girls, naturally compares with that done over here by the Home Arts Society. Of course, the scheme originated in this country and was started with English teachers, but the lines followed seem to have been sound and some persons connected with the undertaking, whether teachers or students it is of course impossible to say, appear to be gifted with a real sense of colour; for both in the copies of Oriental work and in the original designs the colour schemes are entirely satisfactory. This pleasing effect may be in part due to the creamy colour of the angora wool, but it is, in some degree at least, the result of deliberate choice. Altogether, this small exhibit from the Transvaal compares favourably in the matter of taste with similar stuffs produced under more or less the same sort of conditions in this country.

The Orange River Colony sends an exhibit of the work done in the normal schools at Bloemfontein and Bethlehem. The show consists entirely of lace and embroidery and is very small. There is nothing remarkable about the technique of the specimens exhibited, and here again, the guiding influence is plainly British, but the work is, some of it, quite tasteful, and the students evince a desire to do work which bears some impress of the country in which it was produced. The happiest piece of work is a bit of embroidery representing four very brilliantly coloured locusts which shows a rather daring sense of colour. The discovery that the name of the student responsible for it is partly Spanish and partly Dutch,

raises the question in how far her colour sense may be due to training and in how far to heredity.

Turning to native work; while the woodcarving is rude in the extreme and the beadwork will not bear comparison with that of the North American Indians, there is some very pretty and elaborate basketwork, notably from Natal and Rhodesia. If this kind of thing is produced in any quantity, it is rather surprising that we do not see more of it in the London shops.

GENERAL NOTES.

Paspalum Grass.—Mr. B. Harrison, of Burringbar Tweed River, New South Wales, has written an account of the *Paspalum Dilatatum*, a grass which has been found of great value to the stockowner and dairy farmer of Australia. It was introduced into Australia by the famous botanist, Baron Von Mueller and the late Mr. W. Farrer of the New South Wales Agricultural Department. In swampy country, which is the natural habitat of the grass, it grows well, and in the Tweed district it frequently attains the height of nine or ten feet. It is said to have proved very effectual in preventing and subduing the growth of noxious weeds. The reports of experience from various parts of Australia which have been printed are favourable.

Danish Shipping Profits.—For some time past the fact that the value of Danish imports is always much higher than the value of the exports, and that this difference has grown to over £5,000,000 annually, has caused some anxiety among Danish State economists; and some years ago the Government, under the belief that it would be of great interest to know, as far as possible, what profit the Danish shipping trade brought to the country, asked the shipowners to send in voluntarily the information required. They neglected to do so, and in March, 1904, a law was passed by the Rigsdag directing them to do so. This law came into force on January 1st, 1905, and in his report on the trade and shipping of Denmark for the year (Cd. 3283), Mr. Funel, Acting British Consul at Copenhagen, says that the particulars for the year are now available. The total amount of profit was £3,400,000, of which £2,430,000, or 71 per cent., were received on the trade between foreign countries, while £970,000, or 28 per cent., were received on the trade between Denmark and foreign countries. These £3,400,000 must, therefore, be supposed to be Denmark's gross profit on the transport of Danish and foreign goods between foreign ports and between Denmark and foreign ports. However, it must be supposed that over half of this sum remains abroad for covering various expenses. The greater part of the total is, of course, carried by the steamers, the share of the sailing ships being only 13 per cent.

MEETINGS OF THE SOCIETY.

Ordinary Meetings.

Wednesday Evenings, at 8 o'clock:—

March 20.—"Smoke Prevention in Factories and Electric Supply Stations." By John B. C. Kershaw, F.I.C. Sir Joseph W. Swan, M.A., F.R.S., will preside.

Papers for meetings after Easter:—

"The Underground Water Supply of the Thames Basin." By Clayton Beadle.

"Hungarian Arts, Home Industries and Commerce." By Louis Felberman.

"Trypanosomiasis or Sleeping Sickness." By Herbert W. G. Macleod, M.D., B.Sc.

"The Cultivation of India Rubber." By Herbert Wright, Controller of the Government Experimental Station, Ceylon.

"Aerial Navigation." By Major B. F. S. Baden-Powell.

Indian Section.

Thursday afternoons, at 4.30 o'clock:—

May 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By Sir Edward Charles Buck, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

May 30.—"Irrigation Colonies in India." By Laurence Robertson, I.C.S., Under Secretary to the Government of India, Revenue Department.

Colonial Section.

Tuesday afternoons, at 4.30 o'clock:—

April 23.—"Social and Economic Conditions in Australia." By the Hon. John Winthrop Hackett, LL.D.

Applied Art Section.

Tuesday evenings, at 8 o'clock:—

March 19.—"Oils, Varnishes and Mediums used in the Painting of Pictures." By A. P. Laurie, M.A., Principal of the Heriot-Watt College, Edinburgh. Sir Luke Fildes, R.A., will preside.

April 16.—"Joinery and Furniture Making." By A. Romney Green. Halsey Ricardo will preside.

April 30.—"Lustre Pottery." By William Burton.

May 28.—"Sheffield Plate and Electro-plate." By Sherard Cowper-Coles.

Cantor Lectures.

Monday evenings, at 8 o'clock:—

Prof. Herbert Jackson, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

MEETINGS FOR THE ENSUING WEEK

MONDAY, MARCH 18...Surveyors, 12, Great George-street, S.W., 8 p.m. Discussion on Mr. A. J. Spencer's paper, "The Agricultural Holdings Act, 1906."

British Architects, 9, Conduit-street, W., 8 p.m. Sir Charles Nicholson and Mr. Hubert C. Corlette, "Modern Church Planning."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. G. E. White, "Survival of Primitive Religion amongst the People of Asia Minor."

TUESDAY, MARCH 19...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Dr. A. Laurie, "Oils, Varnishes, and Mediums used in the Painting of Pictures."

Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. Stirling, "The Visual Apparatus of Man and Animals." (Lecture VI.)

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 8 p.m. 1. Messrs. H. Nutton and H. D. Law, "The Potential of Hydrogen liberated from Metallic Surfaces." 2. Messrs. F. M. G. Johnson and N. T. M. Wilsmore, "Electrode Potentials in Liquid Ammonia." 3. Mr. J. G. A. Rhodin, "The Impedance of Solutes in Solvents as manifested by Osmotic 'Pressure.'" 4. Dr. Slater Price, "The Electrololytic Deposition of Zinc, using Rotating Electrodes." (II)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. George Andrew Hobson, "The Victoria Falls Bridge."

Statistical, 9, Adelphi-terrace, Strand, W.C., 5 p.m. Mr. Noel A. Humphreys, "The Alleged Increase of Insanity."

Pathological, 20, Hanover-square, W., 8½ p.m.

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Viscount Mountmorres, "The Commercial Possibilities of West Africa."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. The Hon. J. H. Turner, "Forestry in British Columbia."

WEDNESDAY, MARCH 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. John B. C. Kershaw, "Smoke Prevention in Factories and Electric Supply Stations."

Meteorological, 25, Great George-street, S.W., 7½ p.m. Major B. F. S. Baden-Powell, "The Exploration of the Air."

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. James Murray, "Some South African Tardigrada." 2. Exhibition of Specimens of British Mycetozoa by Mr. Alfred E. Hilton.

United Service Institution, Whitehall, S.W., 3 p.m. Colonel F. N. Maude, "The Factor of Mobility in Strategy."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 12 a.m. Annual Meeting. Address by the Chairman, the Earl of Glasgow.

THURSDAY, MARCH 21...Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John street, Adelphi, W.C., 12 a.m., Morning Meeting. 1. Mr. W. J. Luke, "Some Points of Interest in the Construction and Launch of the *Lusitania*." 2. Mr. S. J. P. Thearle, "The Evolution of the Modern Cargo Steamer." 3. Signor C. Piaggio, "Cranes for Shipbuilding Berths." 7½ p.m., Evening Meeting. 1. Mr. Archibald Denny, "Torsiometers as Applied to the Measurement of Power in Turbine and Reciprocating Engines." 2. Mr. J. Hamilton Gibson, "Torque of Propeller Shafting: some Conjectures, Investigations, and Results." 3. Mr. G. Simpson, "Propeller Struts."

Optical, 20, Hanover-square, W., 8 p.m. Mr. J. H. Sutcliffe, "One-Position Ophthalmometry."

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Messrs. E. A. Newell Arber and John Parkin, "The Origin of Angiosperm." 2. Exhibition of Water-colour Sketches of Alpine Flowers, by Miss Helen Ward, and Photographs of Transvaal Trees and Tree Scenery, by Mr. J. Burtt Davy.

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. Emil Fischer, "The Synthesis of Polypeptides." 2. Mr. F. S. Kipping, "Organic Derivatives of Silicon." Part III. "Dl-benzylmethylethylpropylsilicane and Experiments on the Resolution of its Sulphonic Derivative." 3. Mr. H. J. H. Fenton, "The Reduction of Carbon-dioxide to form Aldehyde in Aqueous Solutions." 4. Mr. G. T. Moody, "The Mechanism of the Rusting of Iron." 5. Messrs. R. S. Morrell and A. E. Bellars, "Some Componnds of Guandine with Sugars." Part I.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. C. W. Saleeby, "Biology and Progress." (Lecture II.)

Electrical Engineers, 25, Great George-street, S.W., 8 p.m. Mr. J. A. Panton, "Rail Corrugation."

Historical, Lecture Hall, Field-court, Gray's-inn, W.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 6½ p.m.

FRIDAY, MARCH 22...Naval Architects (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C. Annual Conference continued at 12 o'clock Morning Meeting:—1. Sir William H. White, "Experiments with Dr. Schlick's Gyroscopic Steadying Apparatus." 2. Mr. A. W. Johns, "Approximate Formulæ for Determining the Resistance of Ships." 3. Mr. J. G. Johnstone, "The Application of the Integraph to Ship Calculations." 7½ p.m. Evening Meeting:—1. Professor Vivian B. Lewes, "The Prevention of Fire at Sea." 2. Mr. Lyonel Clark, "Modern Floating Docks." 3. Professor Vivian B. Lewes, "Some Phases of the Fuel Question."

Royal Institution, Albemarle-street, W., 9 p.m. Professor J. J. Thomson, "Rays of Positive Electricity."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. F. J. Kean, "A Point in Turbo-Alternator Design."

Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

SATURDAY, MARCH 23...Royal Institution, Albemarle-street, W., 3 p.m. Prof. J. J. Thomson, "Röntgen, Cathode, and Positive Rays." (Lecture VI.)

CORRECTION.—Page 456, column 2, line 15, the words "its northern" are misplaced. The sentence should read "district in Kent marked approximately by the lined area on the map, Fig. 1, its northern and eastern boundaries," &c.

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FRIDAY, MARCH 22, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

APPLIED ART SECTION.

Tuesday evening, March 19; SIR LUKE FILDES, R.A., in the chair.

The paper read was "Oils, Varnishes and Mediums used in the Painting of Pictures," by A. P. LAURIE, M.A., D.Sc., Principal of the Heriot-Watt College, Edinburgh.

The paper and report of the discussion will be published in the number of the *Journal* for April 5.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, March 5, 1907; SIR FRANK SWETTENHAM, K.C.M.G., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said there was probably no one better able to deal with the wide subject covered by the title of the paper than Sir William Treacher. For a number of years he lived in Labuan, where he had an opportunity of studying Brunei; he was subsequently in the service of the British North Borneo Company, and was the first Governor of British North Borneo. Having completed his term of office there he went to the Malay States, and filled in succession the offices of British Resident in Selangor and in Perak; and, after sixteen years' service there, he became Resident General of the Federated Malay States. The audience would, therefore, realise that Sir William was eminently qualified to deal with the subject he had chosen, he felt sure that the lecturer would hold their attention, and he now asked him to read his paper.

The paper read was—

BRITISH MALAYA, WITH MORE ESPECIAL REFERENCE TO THE FEDERATED MALAY STATES.

By Sir WILLIAM HOOD TREACHER, K.C.M.G.
Late Resident-General of the Federated Malay States.

I was invited to read a paper "about the interesting but not too well known part of the Empire" with which my official career was connected, the reference being to the Federated Malay States, and as my official career since the year 1871 has brought me into more or less contact with the Crown Colony of Labuan, off the North-west coast of Borneo, the State of Sarawak, the territory of the British North Borneo Company, the Sulu Archipelago, the State of Brunei, the Federated Malay States, and the Crown Colony of the Straits Settlements, I thought it would not be amiss to assume for my paper the somewhat ambitious title of "British Malaya." I may add that Sir Frank Swettenham's great work, with the same title but with a different connotation, had not then been published.

The term "British Malaya" as a geographical and political expression I first heard employed by my distinguished chief, our present Chairman, Sir Frank Swettenham, at a farewell banquet to him on his relinquishing the post of Governor of the Straits Settlements and High Commissioner for the Federated Malay States, towards the close of 1903, when, after giving expression to his love for the Straits Settlements, in which and in the neighbouring Malay States the whole of his brilliant official career had been passed, he looked forward, in the somewhat distant future, to the possibility of a Malay Empire of the British Crown, comparable in some respects with the British Indian Empire, and comprising Burma, the Malay Peninsula, the Straits Settlements, and Northern Borneo. The countries I have enumerated comprise roughly an area of 351,600 square miles, with a population of

about 12½ million people. It will help you to comprehend the figures of area if I remind you that that of France is 207,218 square miles.

Probably most of you have read Mr. C. P. Lucas's first volume of his standard work, a model of exact compression, "A Historical Geography of the British Colonies," the second edition of which has recently been revised and brought up to date by Mr. R. E. Stubbs, and you will remember that after pointing out that Great Britain has possessed herself of outposts to the three great European Peninsulas—Spain (Gibraltar), Italy (Malta), Greece (Cyprus)—outposts which lead to the East, and are stations on the road to India and Australia, he reminds us that the three southern peninsulas of Asia—Arabia, India, and the Malay Peninsula — are magnified editions of those three European peninsulas, and that of these three southern projections of Asia and of some of the islands adjacent thereto, Great Britain has, in her course of expansion, also laid hold, for instance, in respect of Arabia, Aden, Perim, and Socotra, the whole of the Indian Peninsula and Ceylon, the Malay Peninsula, including Burma, Northern Borneo, Singapore, and many other islands in the Indian Ocean.

It is in regard to the last-mentioned peninsula and islands that I propose to ask your attention for a very brief period. I trust I am not transgressing any rule or custom of the Society, but I should like first to let imagination run round what might have been before dealing with what is and what is likely to be. What might have been, it seems to me, is, that our British Malay Empire might have included Burma, the Straits Settlements, the Malay Peninsula, Java, Sumatra, Borneo and other islands of the Malay Archipelago, with an aggregate area of over a million square miles, and a present population of about 49 millions. The British Indian Empire has an area of some 1¾ million square miles.

You will, perhaps, ask why? And I have only time to point out quite shortly that of the countries mentioned we do now actually either possess or control all the following, namely, Burma, the Straits Settlements, the larger portion of the Malay Peninsula, and Northern Borneo, while the others have been let slip only through our own supineness; for, as regards Java, the London East India Company in 1601, or thereabouts, established themselves in the island at Bantam, and at Batavia some 20 years later; and, though eventually driven out for a time by the Dutch, the island, probably one of the richest in the world, was captured by an expedition sent out by the East India Company, under Lord Minto, in 1811, and administered for five years by that great Empire builder and founder of Singapore, Sir Stamford Raffles. Unfortunately, under the Treaty of 1814, this magnificent island was restored to the Dutch in the year 1816.

Then, as to Sumatra, another remarkably fertile island, whence now comes some of the best wrap tobacco leaf, and also pepper, gold, and coal, we find that the same company established stations there in the early part of the seventeenth century, the principal of which was at Bencoolen, of which Sir Stamford Raffles was made Lieutenant-Governor in 1817; but again, most unfortunately, under the Treaty of 1824, the English possessions in the island were given up to the Dutch in exchange for Malacca. The British. however, retained certain rights in Achin, the native capital of the island, until so recently as 1871, when "England abandoned all her interests in Sumatra and ignored her Treaty responsibilities to the Sultan and people of Achin," as Sir Frank Swettenham puts it in the book I have already mentioned, "in return for Dutch possessions, of doubtful advantage, on the West Coast of Africa, with the result that we were immediately saddled with the Ashanti expedition, which cost a good many lives and £900,000, while the Dutch entered light-heartedly into an attack on Achin, which after 33 years of fighting and enormous sacrifices in blood and treasure, is not concluded yet."

The Dutch have since been left in peaceful occupation of their rich island colonies, so far as regards interference from other European nations, and admirable Colonial administrators they have eventually proved to be, as you may infer from the fact that the Island of Java, with an area of 50,554 square miles (almost exactly that of England without Wales), has a population of nearly thirty million against England's 30,800,000, and produces a sufficient supply of food for the consumption of its own population besides exporting coffee, sugar, and other products to Europe.

In 1861 an Indian civilian, Mr. J. W. B. Money, who had visited Java, was so impressed with the Dutch methods of administration that he published the results of his investigations in a two-volume book, entitled "Java, or How to Manage a Colony." In 1887 I was returning home from the East in a German liner, and, while passing by Sumatra, the captain, an

excellent specimen of a cultivated German, pointing to the distant land, remarked to me that the eventual destiny of the Dutch East Indian possessions was annexation to Germany.

Finally, as regards the Island of Borneo, after Australia and New Guinea the largest island in the world, and of which only about one-third is under the protection of Great Britain, the remaining two-thirds belonging to the Dutch. Leaving out of view the original connection of Portugal and Spain with this island, and coming to the period when those early colonising nations had, to all intents and purposes, been replaced by the British and the Dutch in the Malayan Archipelago, we find that Dutch and British dealings with Borneo commenced almost simultaneously, at the beginning of the seventeenth century, when the English opened somewhat unsuccessful stations on the east coast of the island, and later on at Banjermassin on the south, and Pontianak on the west coast, and it was not until 1818, under the terms of the treaty to which reference has already been made, that the British retired from Borneo, except the northern portion, in favour of the Dutch.

I may here say that I have not included the fertile Philippine Islands in my list, but I might have done so, and would remind you that in 1761, the East India Company's fleet, under Admiral Drake and Sir William Draper, captured Manila. The natives of the Philippines are of Malayan type.

I fear I may have wearied you by these references to the might have been, but it is good that we should sometimes have brought back to our recollections some of the works and deeds of our ancestors, whose enterprise amidst difficulties, many of which have been mitigated by the advance of science—the invention of steam, for instance—laid the foundation of our dominions and trade beyond the seas, and to whom we owe it that these little islands are the centre of an Empire, the greatest the world has yet seen, instead of an appendage of some more enterprising nation of the West.

From the point of view of ethnology the idea of a united British Malay Empire, comprising the countries I have referred to, is quite a sound one. In the first place all the countries named are peopled by Mongol or Mongoloid races — Burma by the Tibeto-Indo-Chinese branch of the Mongol family, the Malay Peninsula, Java, Borneo, and the Philippines by the oceanic Mongol division of that branch; so that the Burman may be called a Mongolian cousin of the Mongolian Malay. In regard to the last named group, we find that there existed, and in some cases still exist, an aboriginal race of Negritos, a division of the Ethiopic family (brachy-cephalic, or with heads approximately round horizontally), such for instance as the Semangs in the Malay Peninsula, the Kalangs in Java, and the Aetas of the Philippines. These were followed by Indonesians, dolichocephalic people, that is to say long-headed horizontally from back to front, a main branch of the Caucasic family, the highest family of the Hominidae, and to which we have the honour to belong. Existing examples of these are the Sakai of the Malay Peninsula, the Tenggerese of Java, the Land Dyaks of Sarawak, the Dusuns, Muruts and others of North Borneo, the Igorrotes of the Philippines. The Indonesians drove the earlier aborigines to the recesses of the interior, and were in turn bundled after them by the Mongoloid Proto—or savage Malays, such as the Sea Dyaks of Sarawak, the Jakuns of the Malay Peninsula, and the Sundanese of Java, who in turn gave way to the present real Mohammedan Malay who had become, in a measure, civilised in his Sumatran home. Of course, there has been a good deal of mixing between these races. As Mr. R. Shelford, to whom and to Mr. W. W. Skeat and Dr. Hose I have to express my deep obligations, has pointed out to me the Mongol has left his mark on all the people with whom he has come in contact, and if the contact is close enough and prolonged enough he either drives them out or fuses with them, and in one way or another swamps them. By the courtesy of Lady Murray, Messrs. Bampfylde, Leech. Knocker, and the British North Borneo Company, and others, I hope to be able to shew you slides illustrative of most of the races alluded to.

Ethnological questions are of entrancing interest, but cannot be put into a nutshell nor compressed into a ten minutes' conversation. In the appendix to this paper you will find the subject further elaborated in a paper kindly compiled for me from the works of Deniker and Keane and other well-known authorities by a friend, Mr. Walter W. Skeat, who also writes me as follows, and I commen what he says to your thoughts:—

"What I am most particularly keen about is t necessity for a racial survey, and I do feel that a practical point of this kind might be urged most strongly with great advantage in a lecture before the Society of Arts. The point is, I personally believe, not only material, but of vital importance for the maintenance

and development of the Empire. You in Borneo, if anywhere, know how a blood-feud can be avoided by an officer who knows the customs of the Dyak and how to handle them, where a new comer would, by some injudicious decision, in violation of the adat, set the whole country side in a blaze, though dozens of examples will occur if one thinks of them. Allowing for all exaggerations, there is at present a profound movement of native thought and opinion in all quarters of the world, a sort of native chauvinism, which, when it grows to its full height, will make unintelligent and unsympathetic government an exceedingly difficult matter."

It is time to return to actualities and to consider the Malayan countries which at the present day look to the King-Emperor, Edward VII. as their over-lord.

First as to Burma. That country is a province of the British Indian Empire, but then so, at one time, were the Straits Settlements. Its area is 238,738 square miles, or some 30,000 square miles more than the contents of the German Empire. Its population is put roughly at 19½ millions; its revenue at over 5 million pounds; and its Civil expenditure at 2½ million; its aggregate sea-borne trade is a good deal over 20 million pounds. It is mainly an agricultural country, and rice forms two-thirds in value of the gross total of exports, the next largest item being teak wood. I am sorry I cannot here deal at greater length with this province. A recent book, full and overflowing with facts, is Sir George Scott's "Burma, a Handbook of Practical, Commercial, and Political Information."

Now, I will ask you to travel with me to Northern Borneo and land in Sarawak. Here we strike an episode which yields a breath of the heroic ages—a theme worthy to have been sung by Homer. I can only attempt to bring back to your recollections the barest outlines, but they are based on the most up-to-date information, kindly forwarded me by my old friend Mr. Bampfylde, Political Agent for the Sarawak Government, in England.

In 1803, a son, James Brooke, was born in India, to an Indian official. The lad entered the Indian army, raised Brooke's Horse, and distinguished himself and was dangerously wounded in the Burma War of 1824-25; was invalided home; was wrecked on his return voyage to India; eventually resigned the service, purchased a brig and made an unsuccessful trading expedition to China; returned to England; sailed in his yacht the *Royalist* of 140 tons; reached Singapore; at the request of the Chamber of Commerce proceeded to Sarawak, a province of the kingdom of Brunei, on a mission of thanks to a Malay Raja who had rendered assistance to the shipwrecked crew of a British vessel, and became his friend; on a subsequent visit he took charge of the Raja's forces, put down a rebellion, prevailed with the Raja to spare the lives of the rebels, who became his life-long friends, while his influence with the Raja was augmented; a Chief attempted to poison him, failed and was disgraced, and the Raja—whose action was confirmed by his nephew, the Sultan of Brunei—handed over the Government to James Brooke, Raja of Sarawak, in September, 1841, Brooke then being aged 38.

His view of his position I will give in his own words, as recorded in his journal. After narrating the incidents relative to the transfer of the country, he says:—

"Difficulty followed upon difficulty; the dread of pecuniary failure, the doubt of receiving support or assistance; this and much more presents itself to my mind. But I have tied myself to the stake, I have heaped faggots around me, I stand upon a cask of gunpowder, and if others bring the torch I shall not shrink I feel within me the firm, unchangeable conviction of doing right which nothing can shake. I see the benefits I am conferring. The oppressed, the wretched, the outlawed have found in me their only protector. They now hope and trust; and they shall not be disappointed while I have life to uphold them. God has so far used me as a humble instrument of his hidden Providence; and whatever be the result, whatever my fate, I know the example will never be thrown away."

Single-handed, with but comparatively a small private capital, the whole of which he sank in the country, with no support from a Government or a Chartered Company at his back, he had to organise administration, suppress piracy, head-hunting and intertribal wars and break the power of tyrannical and oppressive Malay and Dyak chiefs.

In the suppression of piracy he had the whole-hearted sympathy and assistance of the late gallant Admiral Sir Henry Keppel, who fortunately happened to be in those waters at that time, but the final blow to piracy was not given till 1862, when the then Raja Muda (Capt. Brooke Brooke) met and utterly destroyed, off Bintulu, a large piratical fleet, on its return from a cruise round Borneo.

The Province originally acquired was of small area, some 3,000 square miles, with a coast line of 60 miles, but in 1853 a large extension was gained by the cession by the Sultan of Brunei of the country up to and

including the Rejang River, thus bringing the warlike Sea-Dyaks under Brooke's government.

The task of subduing these warrior tribes into order was assigned to a young ex-naval officer, of the age of 24 years, now the present Raja, Sir Charles Brooke, of Sarawak, and by a rare combination of sympathetic personality and love of hard fighting, the task was in due time successfully accomplished, and the affection of the Sea-Dyaks secured by this young nephew of the Raja.

In carrying out his noble mission the old Raja was sorely tried in many ways apart from financial considerations. I will give two instances.

It had been Brooke's hope that the British Government would take his country under its protection, and possibly eventually add it to the Empire, and his disgust and disappointment may be imagined when in 1853 his proceedings in connection with his expeditions against the pirates were violently attacked in the House of Commons, and on the motion of Mr. Hume, a Royal Commission of Enquiry was appointed—even though the Commission's decision was in his favour. The Little Englanders of the time prevailed, and the opportunity of annexing Sarawak was lost. Then, again, before his advent, Chinese from Dutch Borneo had made many attempts to work the rich gold and antimony deposits in upper Sarawak, but suffered severely at the hands of the Malays; with the security which followed the introduction of good government by the Raja, the Chinese increased and multiplied and waxed fat and insolent, and rose against their benefactor in 1857, seized and destroyed the capital, Kuching, many Europeans losing their lives, but eventually were either nearly all killed or driven over the border by young Brooke and his Sea-Dyaks. This delayed progress for many years and crippled the Raja's capital resources. However, the late Baroness Burdett-Coutts, always his devoted friend, stepped in with some financial assistance; later on she presented the Sarawak Government with a steamer, and further showed her interest in the State by inaugurating experimental farms and rice husking mills.

Sir James Brooke—he had been made a K.C.B. in 1848—spent the closing years of his life in England, on a property presented to him by the public, where he died in 1868.

In 1863 the British Government had recognised Sarawak's independence of Brunei, but it was not until 1888 that it was formally recognised as an independent State under the protection of Great Britain, such protection conferring no right to interfere with the internal administration of the State, its foreign relations alone being placed under British control.

I have already made allusion to Sir James Brooke's successor, his nephew, the present Sir Charles Brooke, G.C.M.G., who, faithfully carrying out and developing the ideas of his uncle, now rules as an independent sovereign over a contented and prosperous Sarawak, which, from a territory of 3,000 square miles in extent, has grown, by absorption from Brunei—which, as you will see by the map, it completely surrounds—into a State of 50,000 square miles, with a population of over 400,000 (including 45,000 Chinese), the capital, Kuching, with a population of 28,000, being probably the largest town in the whole island of Borneo. The idea of the Government may be briefly put as—government of the natives by natives and for the benefit of the natives, under white control and direction.

The revenue of Sarawak was, in 1870, 122,842 dols., and its expenditure 126,160 dols.; in 1905 these figures had grown respectively to 1,353,477 dols. and 1,240,523 dols. The aggregate value of its trade in 1864 was 1,172,958 dols., while by 1905 it had increased to 13,422,267 dols. The chief exports are pepper and sago, and in these two products it takes the lead of all countries in the world. It is a large exporter of jungle products, such as inda-rubber, gutta percha, rattans, damar, bird's nests, and timber. Gold, antimony, and coal are also among its exports, the gold being most profitably worked by that wealthy body, The Borneo Company, Ltd., which followed Raja Brooke's fortunes from the first, and has extended its ramifications over so many parts of the East.

As will be shewn in the sequel, Brooke's arrival in Sarawak paved the way for the British occupation of the whole of Northern Borneo, so that he was, in fact, the founder—not only of his own dynasty—but of the Borneo Protectorates of Great Britain and the Crown Colony of Labuan.

His friendship with the Sarawak Raja (whose full name and title was Raja Muda Hassim, heir-apparent to the Sultan of Brunei) and his efforts to repress piracy, which had been a source of advantage, and profit to some of the Brunei Ministers of State, involved Hassim in troubles with his own people—resulting in many of his adherents being killed,

while Hassim himself committed suicide. Whereupon a British squadron took the town of Brunei, and the small uninhabited island of Labuan, with an area of a little over 30 square miles (about the same size as Hongkong) situated some 30 miles from Brunei, was formally ceded to Great Britain, in 1846, Sir James Brooke being appointed its Governor and British Commissioner and Consul-General in Borneo. The little island never fulfilled the expectations formed of it as a trade emporium and shipping centre, nor have the attempts of several companies to work its valuable coal mines hitherto met with substantial financial success. Until 1869 it depended upon grants from the Imperial exchequer, and for a few years after 1889 the administration was entrusted to the British North Borneo Company, but in 1905 that arrangement ceased, and Labuan is now part of the colony of the Straits Settlements. It is interesting to note that so far back as 1774 the East India Company, having been expelled by Sulu pirates from the island of Balambangan, to the North, had established a short-lived trading station at Labuan and also at Brunei.

I have already told you that Sarawak has gradually surrounded and overlapped its parent, the State of Brunei, from the south. The Brunei territories to the north were alienated to a British company under circumstances which I shall be able to explain to you in only a very cursory manner, and the State which, in the days of active trade relations with China, had ruled over the whole of the north of the great Island of Borneo, is now reduced to an area of some 4,000 square miles, the capital which Pigafetta, in 1521, described as containing a population of 25,000 families, is reduced to one of 10,000 or 12,000 souls. The magnificence of the court so eloquently pictured by the same writer has dwindled away and Brunei, shorn of all its provinces, became, in 1905, a British Protectorate, the Sultan taking his orders from a British Resident. This result was secured by the diplomatic ability of Mr. Douglas Campbell, one of the British Residents in the Malay Peninsula.

The most striking feature of the town is that the houses are built on piles in a very beautiful river, and with some stretch of imagination it has been styled the "Venice of the East," canoes taking the place of the Venetian gondolas.

The growth of the British North Borneo Company's territory arose in this wise:—

In 1865, a syndicate in the United States obtained certain concessions from the Sultan of Brunei, but an American Commodore, who several years after was sent to report to his Government what was going on, informed me that he could find no American subjects in the country, white or black. In 1872 I took short leave from Labuan and proceeded to Sandakan on the east coast of Borneo, now the capital of British North Borneo, with a population of 8,000 or 9,000. Here I found an episode of enterprise which illustrates how the Empire is built up by the individual enterprise of her sons. There was settled Mr. W. Clarke Cowie, now the London managing director of the North Borneo Company, flying the British flag in a little stockaded kampong, surrounded by piratically inclined Sulus, Illanuns, Bajows, &c. It was only a year or two afterwards that a boat from the Austrian frigate, *Friedrich*, was captured by the natives of the neighbourhood and the heads of two of the crew taken round the villages in triumph.

Mr. Cowie had travelled all the way from England in a little 14 ton steamer, and was, at the time I mention, engaged in the fairly lucrative business of running the Spanish blockade of the Sulu Islands, having become on very intimate terms with the Sultan of Sulu, who shared in the profits. I should mention here that the Sulu Sultans laid claim to certain portions of Northern Borneo by alleged cession from a former Sultan of Brunei, and through the Sulus the Spanish Government also claimed, and to finish this part of the subject, I may add that in 1879 I was sent by our Government, in a man-of-war, to Sulu and other ports of North Borneo to publish an official protest against the Spanish pretensions, and later on a protocol was signed whereby Spain renounced all claims to any portions of Northern Borneo and the adjacent islands.

The next important step was the appearance on the scene, in 1877, of Mr. (now Sir) Alfred Dent, the founder of the North Borneo Company, which was incorporated by Royal Charter in November, 1881, after some opposition from the Dutch. The American Syndicate was bought out, arrangements were entered into with the Sultan of Brunei for the cession of 20,000 square miles of territory towards the north, and with Mr. Cowie's assistance negotiations were successfully concluded with the Sultan of Sulu for the cession to Mr. Dent and his friends of all his Highness's rights of any kind in Borneo.

North Borneo has steadily advanced nearer

and nearer to Brunei from the north, as Sarawak has from the south, and its area is now computed at 31,000 square miles. It is a country of great natural fertility in regard to both climate and soil; the cultivation of first class wrap tobacco has been successfully carried on for several years past—I am told the new Darvel Bay Plantation Company last year grew a crop at a cost of about £50,000, which realised over £90,000—and large areas are now being planted with Para rubber, estates which have been opened only for a few years showing an extraordinary and most encouraging growth of that tree.

In regard to mineral wealth, manganese is being worked by a London company in Marudu Bay, and the deposits are estimated to contain some millions of tons. Considerable hopes are, I believe, entertained from the occurrence of very large deposits of iron ore reported to be of excellent quality. Coal occurs in many parts of the territory, and is being worked in Cowie Harbour, while a small area of smokeless coal is reported at Jambongau on the east coast. The alluvial gold has not yet been successfully exploited.

A peculiarity of Sarawak is that it is practically roadless and railway-less, its numerous rivers and steamers sufficing for means of communication. North Borneo, while similarly roadless, possesses a completed railway of 127 miles on the west coast, and is meditating two other lines, one between the Bays of Sandakan and Marudu, 100 miles, and the other an extension of the Tenom line to Cowie Harbour, 160 miles. When we come to the Malay Peninsula we shall find roads and railways and little river traffic.

The population of North Borneo is given as 160,000, but no accurate census of all the interior tribes has yet been possible. The Chinese number some 12,000 or 13,000. The revenue has advanced from £13,220 in 1883 to £113,204 in 1905. The total trade for 1905 is returned as 7,433,757 dols.

I am anxious to get on to the Federated Malay States, which are the main subject of this paper and as the Crown Colony of the Straits Settlements, probably under the name of Singapore, its chief port, is very likely more or less known to you as one of the greatest trading centres in the world, the gateway to the Far East, one of the chain of fortified coaling stations for our fleets, the meeting place for the annual conferences of the Admirals of the East India and China and Australian squadrons, and as recently the scene of Lord St. Aldwyn's labours as umpire in the matter of the taking over by the Colonial Government from an enterprising company of the docks and wharves which are so important and vital a part of the colony's equipment, I will not detain you longer than to put before you a few statistics showing how important and valuable a component part of the Malay Empire the Straits Settlements are.

The area of the colony is 1,542 square miles, and its population, at the census taken in 1901, was 572,249; Europeans numbering about 5,000; Malays, 215,000; and Chinese, 280,000.

May I, in passing, ask you to reflect that the King-Emperor, Edward VII., in addition to ruling over more Mohammedans than any other Sovereign, has in his dominions the largest number of Chinese inhabitants outside of China? In what I have ventured to style His Majesty's Malay Empire alone, there are 715,000 Chinese (Federated Malay States, 300,000; Straits Settlements, 280,000; Burma, 65,000; Borneo, 70,115), whilst the Chinese population of Hong-kong and Kowloon is numbered at 350,000, and that of Wei-hai-Wei at 150,000. These places alone give a total approaching 1¼ million of Chinese, and yet we are making a fuss over some 40 or 50 thousand Chinese miners in South Africa!

For the year 1905 the revenue and expenditure of the colony, exclusive of its municipalities, were respectively 11,657,424 dols. and 10,980,391 dols. Its aggregate trade for the same year was 609,208,773 dols.

Perhaps I ought to tell you that the Straits Settlements are in the main a clearing house for the products of the East and the West, a great coaling and refitting station, and that they hold what are, I suppose, the largest tin-smelting works that exist anywhere, in them being treated the greater portion of the tin ore from the Malay Peninsula.

Singapore possesses a magnificent harbour, the capabilities of which are being extended by the judicious expenditure of colonial funds. Penang harbour also affords good accommodation, and its facilities are likewise being enhanced.

The colony's principal agricultural products are sugar, cocoanuts, and rubber, and pineapples which are commonly to be seen canned for sale in shops here. At Christmas Island, very large deposits of phosphate are being worked by a British company.

The genius of Sir Stamford Raffles secured Singapore for England by cession from the Government of Johore in 1819. Penang was

acquired from the Sultan of Kedah, by the East India Company, in 1785, and the possession of Malacca was finally confirmed to us by the Treaty of 1824.

The Straits Settlements were separated from India and became a Crown Colony in 1867.

I have recently received the third edition of an excellent hand-book, giving information in regard to the Straits Settlements and the Federated Malay States, compiled by Mr. H. Conway Belfield, British Resident of Selangor, and to that work I would refer those who are desirous of further information in a concise form.

Great Britain having obtained a *pied-à-terre* in the Islands of Penang and Singapore, it followed naturally, as it almost invariably does, that she should extend her influence over the neighbouring mainland.

All the southern portion of the Malay Peninsula is controlled by the British, viz., the States of Perak, Selangor, Negri Sembilan and Pahang, now known as the Federated Malay States, aggregating over 26,000 square miles, and in addition the State of Johore nearly 10,000 square miles. Over the rest of the peninsula, with the exception of Trengganu, we have allowed the Siamese to extend their active control notwithstanding that in 1786 the then ruler of Kedah had ceded to us Penang and Province Wellesley on condition of being protected against the encroachments of Siam, and that by the British-Siamese Treaty of Bangkok, 1826, both the contracting parties had agreed not to interfere in the States of Kelantan and Trengganu. The Siamese Government, with the object-lesson before them of the extremely successful results of British regulation of the Peninsular States, has decided to follow, more or less closely, our policy, and amongst other things has appointed Englishmen as Resident and Assistant Resident in Kelantan and has, so far without success, attempted the same action in Trengganu, the Sultan of which State appears to be coy in regard to the flattering attentions from both the Siamese and the British, and to prefer complete independence.

Again following our example, the Siamese have now under consideration the joining up of their Eastern States by a railway to be constructed departmentally by their own Government Railway Department, which is controlled by an official of German nationality. This awakening of Siam in these parts, on European lines, may be watched with interest; and if they adhere to European ideals, and continue, as is now the case, to utilise the services of Europeans, as advisers in regard to finance, railways, forest conservation, law, and so forth, it is possible a fair success may be achieved.

To finish with the matter of Siamese intervention in the peninsula, I may add that by the Anglo-French agreement of 1896, Siam Proper was recognised as a buffer State between British Burma and French Indo-China, and was neutralised, independent action being retained by the British and French reespectively in regard to Siamese dependencies West (British) and East (French) of the neutralised zone. By a subsequent agreement, however, in 1904, both Powers disclaimed any intention of annexing the Siamese territory in their respective spheres of interest.

In regard to Johore I need only say a few words. It is governed independently by the Sultan, who, as well as his late father, the enlightened Abu Bakar, has paid frequent visits to England. Since 1885 its foreign relations have been placed under the control of Great Britain, which has the option, hitherto unexercised, of appointing a British agent in the State. Its propinquity to the flourishing cosmopolitan British Colony of Singapore, and the frequent intercourse thus resulting between the Malay Sultan and the British Governor, has doubtless had a beneficial effect on the form of government, and the same proximity has enabled the ruler to obtain an easy revenue, mainly from opium, spirits, and gambling farms, and export duties on the gambier and pepper cultivated by the Chinese from the colony. The nature of the country is similar to that of the Federated Malay States, but it is at present practically roadless and awaiting development, to which an impetus will be given by the railway which is being constructed out of the surplus revenues and by the railway department of the Federated Malay States. Europeans are entering the country to exploit it for rubber cultivation and tin mining. The present revenue of the State is said to amount to about 1,250,000 dols. a year.

The Federated Malay States may be regarded as quite one of the most successful experiments, presided over by the Colonial Office, in establishing a government with European ideals amongst a tropical people in a country given over to anarchy and confusion, where might was right and the common people held their lives and property at the caprice of their chiefs.

Before we actively took in hand the Malay Peninsula (I will not delay for reference to abortive attempts by the East India Company), the ubiquitous Chinese had for several years been working the rich deposits of tin in Perak and other of the States, and at the time I am referring to they numbered about 20,000 in Perak alone. The two main reasons for our interference were internal strife amongst the Malays, questions of succession to the throne, and so forth, and bloody disputes between rival clans of the Chinese who were working the tin, resulting in piracy along the coast, interference with trade, and excitement amongst the colonial Chinese partisans of the miners in Malaya. The instructions to the Governor of the Straits Settlements precluded his effective interference in the affairs of the Peninsula, but towards the end of 1873 a new Governor, Major-General Sir Andrew Clarke, was appointed, with orders to enquire and report what steps it might be possible to take to remedy matters, as to the advisability of appointing British resident officers in the States.

With Sir Andrew Clarke, a many-sided and able man, short was the inquiry and quick the action; without waiting for final instructions from the Colonial Office he, within some two months of his assumption of office, convened a meeting of the Perak Chiefs at the Island of Pangkor, off the mouth of the Perak River, and on the 20th January, 1874, was signed and sealed the Pangkor Treaty, giving birth to the germ of the residential system in the Peninsula, for by this document the Sultan and Chiefs of Perak agreed to the appointment of a British Resident and Assistant Resident in their country, whose advice was to be followed in all questions other than those touching Malay religion and customs, while the collection and control of all revenues and the general administration of the country would be regulated by their advice. Sir Andrew Clarke then attacked the questions affecting the other States on the western side of the Peninsula, and in November, 1874, the appointment of five officers to be respectively Resident and Assistant Resident of Perak, Resident and Assistant Resident of Selangor, and Assistant Resident of Sungei Ujong were gazetted. At the historic meeting at Pangkor there were present the Governor, Sir Andrew Clarke, with Mr. Braddell, Attorney-General, Major McNair, Mr. Skinner, Captain Dunlop, Mr. (now Sir) Frank Swettenham, and Captain Speedy, accompanied by the Mentri and the Temengong; Mr. Pickering, with Raja Abdullah, Raja Dris, Datu Sagor, and Raja Mahkota; Sultan Ismail was absent. Mr. James W. Birch, the Colonial Secretary of the Straits Settlements, was appointed to be first Resident of Perak. He had come from Ceylon, and was a man of extraordinary energy, which has descended to his son, Mr. E. W. Birch, C.M.G., now holding the position first occupied by his father, but under very different conditions. Mr. Birch unfortunately was entirely ignorant of Malay language, customs, habits, and prejudices, and his task was an exceedingly difficult one. I would ask any of you gentlemen here living at home at ease, what would be your feelings if you were suddenly called upon to undertake the administration of a roadless country and the collection and control of all its revenues, where hardly the rudiments of government existed, where there were rival claimants to the throne, where slavery for debt was an institution, and the language, customs, habits and prejudices of the people were unknown to you, and you possessed no force to back you up beyond a small bodyguard of native police?

Time fails now to recount all the antecedent circumstances, but in November, 1875, Mr. Birch was assassinated while in his bath-house on the Perak River. As Sir Frank Swettenham narrates: "Mr. Birch did not die in vain; his death freed the country from an abominable thraldom, and was indirectly the means of bringing independence, justice and comfort to tens of thousands of sorely oppressed people," for there followed on the crime what is known as the Perak War, with the result that Sultan Abdullah was dethroned and exiled and the way made clear for the eventual accession to the throne of the present enlightened Sultan Idris, G.C.M.G.

Mr. Birch was succeeded by Mr. Davidson, transferred from his post as Resident in Selangor. He resigned in less than a year, when Sir Hugh Low was selected for the important post. Mr. Low, as he then was, had started life in the East under the auspices of the great Sir James Brooke, and had early imbibed his love for the Malays and his admirable method of dealing with them, and possessed what had been lacking in the first Resident, a sound knowledge of the Malay language, customs, habits and prejudices, acquired during many years' service in Labuan, where he had close intercourse with the Malays of Brunei and the northern portion of Borneo, and the Chinese

traders. After good, honest, and brilliant work in Borneo and the Malay Peninsula he retired from official service in 1889, leaving a happy, contented, and rapidly progressing Perak in the hands of his successor, our Chairman, who by that time was British Resident of Selangor, and had been identified from the very first with all the negotiations for the introduction of the residential system, *quorum magna pars fuit.*

The remaining State, of the present Federation, Pahang, the largest in area of all—being of greater area than Perak, Selangor, and Negri Sembilan together—is situated on the east coast of the peninsula. In 1887 the Sultan entered into an agreement with Governor Sir Frederick Weld, and accepted a British agent, Mr. Hugh Clifford, now Colonial Secretary, Ceylon, who in the following year, as the sequel to the murder of a Chinese British subject, was replaced by a full Resident, Sir John Rodger, at present Governor of the Gold Coast, after negotiations conducted by Governor Sir Cecil Clementi Smith, who first as Colonial Secretary, and subsequently as Governor of the Straits Settlements, had always taken a keen, able and sympathetic interest in Native States affairs, and in their material development. The Sultan has remained loyal, at any rate superficially, but in 1891 and 1894 a local chief rose up against the Government; the disturbances, however, were quelled by Indian police from the other States and the Straits Settlements without the aid of British troops.

In 1905 an important further advance was made by the Sultans of the different States entering into an arrangement, as the result of negotiations initiated under instructions from Mr. Chamberlain, then Secretary of State for the Colonies, and ably carried through by Sir Frank Swettenham, whereby all the States were federated and a Resident-General appointed to supervise the Residents, and to be the medium of communication with the Governor at Singapore, who was thenceforward styled High Commissioner for the Federated Malay States.

I should like you to fix your attention on the fact that two main points were kept in view in this arrangement, first, that the King's Governor at Singapore should, as High Commissioner, have the power of general supervision and control. I lay stress on this because it bears upon the idea which runs through my paper of a possible British Malay Empire, the centre of which would be the great trade emporium of Singapore, and in furtherance of this view we have now an official who combines the offices of Governor of the Straits Settlements (which include Singapore, Malacca, Penang, Province Wellesley, the Dindings, all in the neighbourhood of the Malay Peninsula, and the Cocos and Christmas Islands in the Indian Ocean, and Labuan, off North Borneo) and of High Commissioner for the Federated Malay States of the Peninsula, and for Brunei, in Borneo, and of Consul-General for British North Borneo, and for the State of Sarawak.

The second point was that while no one of the Sultans can interfere with the affairs of a State other than his own, they agreed that they would give one another such assistance in men, money, or other respects, as the British Government may from time to time advise. I may add a third point, that they undertook, should the British Government become involved in war, to send at their joint cost a body of armed and trained Indian troops for service in the Straits Settlements; this is the origin of the fine body of men, numbering about nine hundred, known as the Malay States Guides, composed of Sikhs and Pathans recruited from India, many of them medalled soldiers of the Indian army, officered by officers from the British or Indian regular army, under the command of Lieut.-Colonel Walker, C.M.G.

Federation came into actual being on the 1st July, 1896, and from that date the Civil Service began to be recruited, no longer from nominated officers, who had so quietly and efficiently done such successful work and insured such successful results, but, like the services of Ceylon, Hong-kong, and Straits Settlements, from officers selected by a competitive examination held in London in combination with the examination for the Home and Indian Civil Services.

In the old days a man was set down in a district, and was told to rely on his personal influence with the natives to introduce order where chaos had reigned, and he was allowed a pretty free hand; with the growth of the country's prosperity and the concomitant increase in the numbers of the Civil Service, a mass of Government regulations necessarily came into being, and less individual scope can now be allowed to the individual officer.

As to the secret of our success in governing Malays, not only in the Malay Peninsula, but also in Sarawak and elsewhere, I will, as time is short, mention only two points:—First

entire sympathy on the part of European officials with the natives, an earnest effort to enter into their thoughts and feelings, which can only be secured by acquiring a knowledge of their language, and by mixing with them in a friendly and not too superior spirit, and above all by being freely accessible to them in one's house or in one's office, whether those who seek an interview are rich or poor, aristocratic or plebian; by encouraging those of their peculiar customs and laws which have an element of good in them or are harmless, discouraging those that are radically bad, degrading or cruel, and by refraining from the endeavour to reform the natives out of all recognition of their natural selves.

The second point, one which applies especially to the Peninsula, where the extraordinary deposits of tin have given us the wherewithal, is a generous but judicious expenditure on public works, roads, and railways. In illustration of this point I may quote from a report on the Federated Malay States made to the Parliament of the Commonwealth of Australia by Senator the Hon. Staniforth Smith. He says, referring to the estimated expenditure of the States for 1906:—

"It is worthy of notice that in Public Works and Maintenance £1,346,528 are to be spent—a sum equal to nearly 60 per cent. of the total revenue. So large a percentage of revenue spent in public works is probably unequalled in any part of the world."

Here I may say that these young States have built over 400 miles of excellently constructed metre-gauge railway, and over 2,000 miles of roads, which put English provincial roads to shame, without borrowing a penny, and are now engaged in extending their railway through Johore to Singapore. At the close of the year 1905, the capital account of the railway stood at 37½ million dollars.

There is still a wonderful deal of misconception of the nature of the Malay. I am frequently asked if treachery is not one of their characteristics, and I unhesitatingly answer, No. This particular misconception was probably initiated by the original merchant adventurers, and we can imagine what reception a body of strange, uninvited white infidels would receive at the hands of Mohammedan Malays whose system of warfare, taking its rise from the nature of the thickly jungle covered country they inhabit, which forms a natural series of fortifications, is adapted more for ambuscades than for fighting at close quarters. Add to this that, being Mohammedans, they were by their religion justified in indulging in piracy and murder where the victims were infidels. The Malay is possessed of at least as much passive courage as the average Englishman, and is probably less troubled by the fear of death and the hereafter than many Christians.

The East, as we know, was the cradle of good manners amongst other things, and the motto "manners maketh man" was, I am sure, in vogue there long before it spread to this country. The Malay, man, woman, and child, noble, peasant, and labourer, is a thorough "gentleman," and in facility of expressing himself, and in his knowledge of the very many things that can be acquired without board-school education, there is no comparison between him and the English son of the soil. I am a lover of the Malay, having known him intimately for over 30 years, and may be prejudiced, and as, furthermore, I cannot detain you much longer, I will refer those of you who want to improve their acquaintance with him to the fascinating description of the Peninsula Malay which will be found in Chapter VII. of Sir Frank Swettenham's "British Malaya."

As to the future of the Malay, I think much can be done if the sympathy which I have referred to as the keynote of our success hitherto is maintained, and on the subject of his education on modern lines would ask your attention to extracts from a letter I received at the end of last year from Mr. R. J. Wilkinson, the then head of the Educational Department. He is referring to a residential school for Malays in the establishment of which I took great interest before retiring from the service:—

"I have just concluded my examination of the Kuala Kangsar Residential School, and I feel sure that you will be interested in the result. The success of the school has exceeded my wildest hopes. I gave the boys the stiffest examination I have ever set in the Federated Malay States, yet 21 boys, including six Rajas, passed with flying colours. They all get 7th standard certificates, and are, of course, qualified for Government service, but most of them will remain on at the school for further instruction. As there are only 80 boys in all at the school, from the A B C class upwards, the proportionate success is quite unprecedented in the Straits and Federated Malay States records. . . . . The most interesting successes are those of Raja Kamaralzaman and of Raja Abdul Aziz, son of the late Perak Raja Muda; the other successful Rajas are more distant connections of the Sultan, but Raja Rashid, a son of the Sultan of Perak, very nearly passed, and is sticking to his work gamely, while the eldest son of the Raja di Hilir has joined the school and is doing most creditably.

The Yamtuan of Negri Sembilan is sending two young sons to join the school after holidays. His two brothers have improved immensely and are devoted to their work and to the school. I am the more pleased at the result because the boys sent to the school were by no means picked boys. The Governor has sanctioned the erection of the new building, and when it is up we shall be able to double our numbers. The Raja Muda of Kedah wishes to send his boys to the school. . . . But whatever happens the results now obtained will eventually dispose of the fiction that the Malays are not capable of being instructed. That 21 boys in a small school of 80, badly housed and ill-equipped should pass a very stiff seventh standard examination, shows that a few good schools could soon supply our Government offices with every clerk we need and make us independent of the Jafna Tamil."

On the other hand, I must admit that the Malay, owing to his environment—the balmy climate making no severe calls upon him in the matters either of food, artificial warmth or clothing—has not the bustling energy of the white man nor the greed for amassing wealth of the Chinaman, nor does he believe in putting forth unnecessary energy for a problematical gain—he is like the English tramp who was always willing—that is to look on at other people working, or like that one who complained that he was an unfortunate medium, too light for heavy work and too heavy for light work.

You will ask what has been the practical outcome of all the efforts I have endeavoured to outline for you, and I can give you, in a brief form, a suggestive idea which you can elaborate for yourselves from the following extract from Sir John Anderson's first report to the Colonial Office after his appointment as High Commissioner, in April, 1904, asking you to bear in mind that Sir John went out straight from the Colonial Office, where he had necessarily acquired the latest and fullest information as to other colonies and Protectorates. Sir John wrote :—

"Not only has law and order been firmly established throughout the whole area, but so far at any rate as the three western States are concerned, they are better provided with roads and railways, public buildings, and all the usual adjuncts of administration and comforts and amenities of civilisation than any of the Crown Colonies of the Empire."

I must not burden you with statistics, and in place thereof I will read for your information what was written in 1904-5, by Mr. Alleyne Ireland, Colonial Commissioner of the University of Chicago, for the purpose of visiting the Far East and preparing a comprehensive report on Colonial Administration in South-Eastern Asia. He says of the Federated Malay States :—

"Their present importance lies in the fact that they furnish the world with more than two-thirds of its total tin supply. As a general indication of the rank into which they fall as part of the British Empire it may be mentioned that their annual revenue is equal to that of Ceylon, exceeds that of Hong-kong and the Straits Settlements added together, and is nearly double that of the whole of our West African Colonies."

As regards tin the following figures of the world's output for the twelve months ended 30th September last should interest you :—

	Tons.
Straits (mainly from the F. M. S.) ..	56,767
Australia	5,065
Banca (Dutch, once a British possession)	9,418
Billiton (Dutch East Indies)	1,810
Bolivia	15,119
Cornwall	4,800
	92,979

The present price of tin is somewhere about £190 per ton. You will understand, therefore, that the main wealth of the Federated Malay States consists of their unrivalled deposits of tin ore, which in the shape of export duty contributed during the year 1905 over a £1,000,000 sterling towards the total revenue for that year. The labour force employed at the mines is chiefly Chinese, with comparatively few Indians, a class which is steadily increasing in number, and for the year to which the above figures relate was estimated at 230,000.

The Chinese miners are recruited from Southern China and do not bring their wives and children with them, nor do they become permanent settlers; they come and go, some under indentures, some as free labourers, and the general average of the labour strength is maintained. I hope to show you some photographs illustrating some of the methods of winning the tin ore, and for a further account must refer you to the appendix, conveying the latest impressions of an experienced mining engineer, Mr. Fordyce Balfour.

The total Chinese population of the States—miners, merchants, traders, shopkeepers, mechanics, coolies, &c.—number over 300,000, and they have hitherto been the main factor in the development of the country, and contribute the larger proportion of its revenues.

Whatever may be the case with South Africa, our Eastern tropical dependencies cannot be successfully opened up without the assistance of the Chinese in the first instance.

A second industry which is making enormous strides is that of rubber planting, but on this subject, as a special paper will shortly be read in this room by an expert, I will not enlarge beyond saying that the Superintendent of Agriculture in his report for 1905 estimated the area then alienated for the planting of Para rubber in the States, at 100,000 acres, of which about 38,000 had already been planted up, the number of trees of all ages, a number since largely increased, being put at 6,000,000 to 7,000,000. A recent return gives the number of rubber estates in the Federated Malay States alone as 143, of which 80 are the property of public companies, with a large amount of nominal and paid-up capital, the remainder being privately owned.

The revenue raised in the States during 1905 approached £2,500,000, and the expenditure over £2,000,000. The balance of assets was considerably in excess of £2,000,000. There is no public debt. The trade of the States in the same year—imports and exports—amounted to the value of over £13,000,000.

If you let these figures and those which I have given for the other countries mentioned in this paper, sink into your minds for a few minutes you will agree with me that these colonies and protectorates, which have not and do not cost the British taxpaper a farthing, and which are increasing in prosperity year by year, are worth cherishing, holding and defending.

In conclusion, allow me to quote a short passage from an article I recently saw in *The Times* newspaper:—

"There is perhaps no conviction more deeply rooted in the mind of the English people than that, of all the glorious features in their long history, the noblest is the rule which they have extended over alien races. They know that since the fall of the Roman Empire no State has had to bear a burden of this kind which can compare with that which they have borne and yet bear. They are proud of the virtues, the sagacity, the courage, and the tenacity by which generation after generation has built up the wonderful fabric. They are prouder still of the enlightenment, the humanity, the patience, and the self-denial with which it has been administered. They sincerely hold that no human institution has ever done so much to promote the welfare of mankind, and particularly of the weak and of the humble who have come beneath its laws."

APPENDIX I.

Features of the Peninsula.

In writing about the geological formation of the Federated Malay States it will be necessary to treat the Malay Peninsula as a whole. The Peninsula is, roughly, 800 miles long, extending from Lat. 14° North to Lat. 1° North. A range of mountains runs the whole length and extends far North through Siam, Burma, and the Shan States. Towards the South end the Peninsula widens out considerably, reaching a width of about 150 miles. Here the range loses its individuality, and is split up into many spurs and other smaller ranges. For the greater part of the 800 miles the range is nearer to the Western seaboard than to the Eastern. The whole of the country is, comparatively speaking, covered with thick impenetrable jungle which makes the study of its geological features extremely difficult and costly, so that even to the present day only a few facts regarding these features are known. There are one or two large rivers which form in certain parts the only means of inter-communication. The tin-bearing areas may be said to extend from the Northern boundary of the State of Johore, covering more or less the whole width of the Peninsula, right through the Federated Malay States, Siamese Malay States, Siam, and Burma. There is the possibility of the whole of the Peninsula being proved to contain tin in more or less quantities. There are large areas in the Peninsula at present lying undeveloped because of transport difficulties. These difficulties no doubt will be, to a great extent, overcome as the country is opened up.

Geology.

As mentioned above, our knowledge of the geological conditions and features does not amount to much, and any opinion that may be formed can only be based on the facts at our disposal. All evidences so far go to show that the main range of mountains with many of the spurs are composed of granites. These granites are usually grey in colour, and are found in all states of decomposition. They vary greatly in character, some are extremely fine-grained, in others large well-formed crystals of quartz, mica (biotite), and felspar (orthoclase) are found. Tourmaline is also found in the granites, in some cases in such quantities as to give the granite a black appearance. The intrusion of the granites has had a great influence upon the overlying rocks. The clays have been metamorphised, contorted and tilted to all sorts of angles. The limestones are highly crystalline, white or grey in colour, and are in some parts of such a character that they are mined and dressed for building and ornamental purposes. They, as well as the clays, have been crushed and contorted by the upheaval of the granites. Laterite in places has been found in large quantities.

Tin.

Tin occurs in three forms:—1. Native tin. 2. Stannite (tin pyrites, sulphuret of tin, tin sulphide).

3. Cassiterite (tin ore, black tin, tin oxide). The only form to be considered is cassiterite, which is usually associated with the granites, slates, and limestones of the Malay Peninsula. It is is also found in this form in the alluvial deposits. It varies in colour from black to yellow, and the crystals, which have a high adamantine lustre, occur in squares, prisms, and octahedrons. Hardness from 6 to 7. Specific gravity from 6·4 to 7·02.

Lode Mining.—Lode mining in the Federated Malay States has so far not played a very important part in adding to the monthly output of cassiterite. It is to be hoped, however, that honest efforts will be made to bring some of the known workable lodes into a well-developed condition. The best example of lode mining in the Federated Malay States is in Pahang. Here the lodes vary from 2 to 10 feet thick, and their value varies from 1 to 15 per cent. of cassiterite. The lodes are in the slates, and are said to penetrate the granites. The geological features here are the usual, viz., granites overlaid by varieties of Schists. Limestone is also found in the district. There are deposits of cassiterite found in the limestones, the best known example being at Lahat, where the tin is found in a matrix of hard crystalline limestone.

Impregnations: Contact Deposits and Stockworks have not, up to the present, been exploited to any great extent, but as the country is opened up, and when prospecting for tin along contacts between slates and granites takes place, there will probably be numerous discoveries of payable deposits. The best known example of a stockwork is at the Bruseh Mine, where the slates have been impregnated with cassiterite in small, thin, irregular deposits. The percentage of tin is low, but as the hills of slates lend themselves to working hydraulically, and as abundance of water with a good head is available, working costs are kept at a low figure. This mine is a good example of how experience and practical knowledge have brought what was anything but a paying concern to one that has a future.

Alluvial Deposits.—The past and present prosperity of the Federated Malay States is entirely owing to the ease with which the alluvial deposits carrying cassiterite have been discovered, their immense area, and their exceeding richness. That these known areas have yielded their best, and that their returns may now be said to be on the decline, goes without saying, and if other areas are not opened up the yield from alluvial sources will show a distinct fall. It does not enter into the scope of this sketch to discuss the origin of alluvial deposits in the Federated Malay States further than to say that all such deposits are the result of disintegration and denudation of pre-existing rocks. Large areas are being and have been worked for cassiterite, but the largest and richest deposit discovered so far was the one in the Kinta Valley. Deposits along sea beaches have been found, but nothing much in the way of proving their value and working them has been accomplished. Alluvial areas are necessarily formed in valleys and lowlands. The deposits are composed of what is called an overburden covering pay gravel. There are different kinds of deposits, and they may be classed as follows:—surface, shallow, and deep. The surface deposits may be of any thickness, from a thin layer to 20 feet and carry more or less tin ore from the surface to the bedrock. Shallow deposits are deposits covered by an overburden, varying in thickness from 1 to 30 feet, the "wash dirt" or gravel carrying the cassiterite may be of any thickness, but usually is not more than 20 feet. There are several instances of more than one layer of pay gravel being met with before bedrock had been reached. There is reason to suppose that in former days what was considered bedrock was not such but really an intervening layer of barren wash which may or may not have covered another bed of payable wash dirt. As these areas have been covered over by the tailings from the former mining operations nothing can prove this but drilling and prospecting the supposed worked out deposits. Several cases are known where the supposed "kong" or bedrock was pierced and another layer of payable "wash" found. Deep deposits may have anything above fifty feet of overburden and may require to be mined to show profits. This is certainly the best way, other conditions being favourable, to work such deposits. The Federated Malay States show several instances of this character, and it says much for the Chinese owners that they have faced their difficulties, and instead of removing great thicknesses of overburden have adopted a method of underground mining.

The overburden usually consists of the ordinary soil and other sedimentary deposits, and may be made up of one or more distinct beds or layers, showing different periods of deposition. The character of the "pay gravel" varies considerably. It may consist of fine sand, clay, clay mixed with pebbles, or free gravel (which has in some cases become cemented) composed of the pebbles and boulders of slates, schists, granite, pegmatite limestone, and gneiss. Other minerals are sometimes associated with the tin oxide such as tourmaline, wolframite, magnetite, cerussite, hornblende, ilmenite, iron and arsenical pyrites, none of these being of any great value. Small quantities of gold have been found in the alluvium. The bedrock is called "kong" by the Chinese miners. The bedrocks of the alluvium are usually china clay, the bleached surfaces of the schists, limestone and granite.

As chinese miners never make any estimate as to the value of their ground—simply stopping work on any area that does not return profits, although it is said that some mine owners have carried on their mining operations at a loss, depending upon the sale of opium, &c., to their workers to recoup themselves—no data are at hand to enable one to calculate the average value of the alluvium. Conditions and circumstances make certain values profitable or otherwise. In the Kinta Valley the average value is given at

about 1 per cent. of tin oxide, and the metallic contents of the ore would run from 60 to 72 per cent. In the Kinta Valley and in other parts very rich pockets of tin oxide have been struck; in some cases the "wash" has yielded 60 per cent. of oxide. Such "pockets" are not often met with.

The method of working the deposits is very simple. Coolies remove the overburden and when the "pay gravel" is reached it is carried up to a sluice where it is worked up with rakes, &c. The pebbles are thrown out to one side and the water running over what is left carries away the sand leaving the cassiterite behind, which is collected. Further cleaning with hand jigs takes place before it is smelted. Where the grains are of one size this simple treatment gives a fair recovery, but where there is fine tin oxide it is lost. This is easily proved by "panning the "tailings" coming from the sluices. Up to the present Chinese methods have prevailed so far, and many Chinese have made large fortunes, but the time is at hand when large areas containing low values will be handled by machinery. The resources of the Federated Malay States are anything but played out. The lode formations are practically unknown. Large returns may yet be got from impregnations and contact deposits which, to my mind, form the source of all the cassiterite in the alluvium. Other areas of alluvial deposits are only waiting the arrival of the intelligent prospector. A certain development has already taken place especially in the state of Perak where machinery is being used to some advantage, but to my mind greater developments will follow, and the main object will be the elimination of the coolie. That the cubic yard can be shifted by coolie labour at a very low figure is granted, but properly designed machinery with practical men in charge will be the means in the near future, and will treat the cubic yard at a very much lower figure than at present.

JOHN FORDYCE BALFOUR.

APPENDIX II.

RACES OF INDO-CHINA.

The term Indo-China is singularly happy, for the first point which has to be considered is the broad line of distinction between the aboriginal races of Indian origin and those of Mongolian descent, between the Malayan race for instance, and the Indonesians. Keane distinguishes the *Indonesians* as the pre-Malay "Caucasic" element in Oceania,* and *Malayan* or *Protomalayan* as the collective name of the "Oceanic Mongols," and *Malay*, as a particular and specialised branch of the Malayan (*i.e.*, Oceanic Mongol) family. Deniker says (without precisely defining the race alluded to) that "Indonesian" is the collective name given to the fairly pure inland races of the large islands (Java, Sumatra, Borneo, for instance) of the Archipelago, and perhaps if what he intends is that it should connote Keane's ("Caucasic") *pre-Malays*, this will be the best means of reconciling their views. The distribution here followed is mainly Deniker's. They are short (1·57 m.) ("mesaticephalic" to "dolichocephalic"), yellow-skinned with hair either straight or slightly waved, and differ widely in many ways not only from the Protomalays or Malayans, but from the Polynesians (somewhat awkwardly called by Keane "Caucasic" Indonesians), who are very tall and fleshy, usually described as short-headed (brachycephalic), with light brown or cinnamon-coloured skins, straight black or wavy black hair, and remarkably regular, sometimes quite European features, and who may be represented (as was pointed out in 1901 in the Report of the Cambridge Expedition to the Siamese-Malay States, read at the meeting of the British Association in that year) by the so-called "Malays" of Kelantan and Patani on the East Coast of the Peninsula. These "Malays" to some extent resemble the Maoris, though there are differences, and it is possible they may represent a less developed branch of the same race. The Indonesians are represented by the Battaks, Nias, and Kubus of Sumatra, the Tagals of the Philippines, the Dayaks of Borneo, Nicobarese and Nagas. According to some authorities the Indonesian type is also present modified by "Hindu" (*sic*) elements in the island of Java, and with Mongoloid elements among the Khamti and elsewhere.

In Indo-China there are both the probable aborigines and the mixed races produced by crossings between these aboriginal races and invaders from neighbouring countries. Of the former there are eleven chief groups, of the latter five.

A.—Of the aboriginal races, there are the following divisions:—

(1.) The Mois (Peunongs of Cambodia), Khas of Laos, uncivilised tribes scattered over the mountainous country between the Mekhong and the coast of Annam; as a rule short (1·57 m.), long-headed, more or less wavy-haired, straight-eyed. Differing greatly from Annamese and the Thại (who are both Mongoloid races) they are probably Indonesians. Hunters or husbandmen (of a very simple type), they go almost nude, and employ spears and poisoned arrows.

(2.) The Kuis, in south-east Siam and in north-west Cambodia, also in Keng-Tung (Shan States). They are short (1·63 m.), and the head is inclined to be short (brachycephalic); they speak Cambodian, and are good smiths.

(3.) The Mons or Talaing, remnants of a (according to Keane, old "Dravidian") race which once covered

* There are in reality two forms or types of what Keane calls the "Caucasic" element in the region here discussed (1), an undeveloped or aboriginal type represented by the Veddas [often called "Dravidians" the equivalent of Keane's Indonesians, though this is taken exception to as possessing a merely linguistic connotation] and (2) a more developed or specialised type, as represented by the tall brown-skinned Polynesians. If this fact is borne in mind it will clear up many apparent discrepancies. Frequent mention is made of "Malayo-polynesian" elements, but it must be remembered that this term is also properly confined to language.

the whole of Lower Burma, driven into the unhealthy deltas of the Irrawaddy, Salween, and Sittang. The Talaing language is the oldest literary vernacular of Indo-China, but is fast dying out, and is practically unknown outside a very limited range, though it is the original tongue from which as a model Burmese literature took its inspiration, and in which were composed the Peguan chronicles commencing in about the 6th century A.D., and recently edited by P. W. Schmidt.

(4.) The Cham (inhabitants of Champa) are closely allied (in language, though probably not in race) to the Malayan family; indeed, MM. Aymonier and Cabaton, in their admirable dictionary of the Cham language recently published, state that they regard the language as properly a Malayan dialect, and to anyone who has a good knowledge of Malay the correspondence is striking. Their alphabet is of Indian origin, and they inhabit parts of Southern Annam, Cochin China (Baria), and Cambodia. They are the existing representatives of a once powerful race, the founders of the empire of Champa, which included the whole of Annam and South Tongkin. A few are Mohammedan, but most are animist. They are handsome, with almost aquiline nose, eyes without the mongoloid fold, wavy or frizzy hair, and dark skin. It is the woman who asks the hand in marriage (contrary to the custom of other Indo-Chinese races).

(5.) The Karens are found in the less accessible parts of the Irrawaddy delta and the hill country to the east and south-east from which they spread into Siam. The ordinary Karen is distinguishable from the Burman chiefly by a difference of expression in the eyes. They are also found in the country between the Sittang and the Salween (Red Karens), and probably came into Burma* later than the Mons. They are short (1·64 m.), sturdy, with straight black and even brownish hair, light-brown skinned, and seem "half-way between Malays and the Thai." A less common type possesses the regular features, long oval face, pointed chin, and aquiline nose of the European.

(6.) The Chins inhabit the hills between the Irrawaddy and Bay of Bengal. They vary greatly in type, and are often of poor physique. Their dialects are classed with Burmese and Kachin.

(7.) The Kachins inhabit the extreme north of Burma, and were advancing southwards when their course was checked by the British annexation. They are believed to be a later uncivilised branch of the same stock as the Burmese, often have long straight noses, and are hardy and warlike.

(8.) The Nagas of Manipur and the northern ranges are fairly pure Indonesians. Various peculiarities, such as head-hunting, and many coloured hair or feather ornaments, long shields, breast-plates, methods of weaving, and communal houses connect them with the Dayaks and other Indonesians.

(9.) The Salons (or Selungs) are classed by some as Indonesians, by others with the Jakun, or aboriginal Malay races. They number only about 1,000. They are Orang Laut (Kipling's "Orange Lord," though this version hardly indicates the correct pronunciation) or Sea-gypsies, and live in the Mergui Archipelago wandering from one island to another. They pass their entire life in their boats, in what may appear somewhat confined and miserable quarters, but from which they seem to suffer no real inconvenience. They are wonderful divers, and collected pearls until the shallower waters were fished out. They still collect green snails, zostera (seaweed), *bêche de mer*, and other marine products, and employ the harpoon, which they follow up by diving into the sea after it.

(10.) We now come to the Pagan races of the Malay Peninsula, of which there are three well-defined groups, the most northerly being the Semang, roughly speaking opposite the island of Penang, the Sakai occupying the centre of the peninsula, more especially south-east Perak and north-west Pahang, and the Jakun, a composite race, with Malayan speech and culture, commencing in Selangor, and extending to Johore and the islands beyond, and including Singapore. The first of these races may be described in its purest type as consisting of woolly-haired tribes, the second (Sakai) as wavy-haired, and the third (Jakun and Orang Laut) as smooth or straight-haired tribes. The problem which here confronts us is how to trace the origin of these races There are no existing records to assist us, and all we have to go by are racial characters and language. As far as the evidence goes, the Khmer and Annamese tribes came from the southern boundaries of China, and spread out like the spokes of a fan towards the north of India, Burma, and Indo-China, the result being that it is possible to trace a connection both in language and race between the Malay Peninsula and the extreme west of the North-west provinces of India.* Before the Burmese and Siamese invasion the Mons lived in Pegu, the Khmer in Camboja, and the Annam in Tongkin, the latter gradually working down the eastern coast of Indo-China. The question is whether the Sakai belong to the so-called "Dravido-Australian" (*i.e.* "Indomesian") race, allied to the Vedda, Korumba, and Australian blacks, as suggested by Virchow, or whether they were of Mon-annam or Mon Khmer origin, as suggested by Schmidt. The argument of language is notoriously unsafe, and as the Mon-Annanese were a race partly at least of Mongolian origin, the writer finds it hard to accept this view as stated. Whatever linguistic group the Sakai belonged to, they unquestionably belonged racially to the Indian family, and not, even in part, to that of the Chinese. They may thus proprobably be best classed strictly with the Indonesians, as defined by Keane. It has been suggested that there were two waves of Mon-Khmer influence in the peninsula, one of which was due to the spread of a civilised Mon-Khmer empire, of which no distinct

* For a good coloured race-map of Burma, see Scott-O'Connor, "The Silken East." Hutchinson, 1904.

* See Blagden's race-map in "Pagan Races of the Malay Peninsula," Vol. II., pt. iv.

record survives in history, the other being an irruption of uncivilised members of the same races.

Taking the three aboriginal races of the peninsula in order, we get:—

(1.) The Negritos, belonging to a race which is short (1·49 m.) of stature, short-headed (brachycephalic), dark-skinned (glossy-black to chocolate brown), woolly-haired, round-eyed, and includes (*a*) the Aeta of the Philippines; (*b*) the Semang or Pangan of the Malay Peninsula; and (*c*) the Negritos of the Andaman Islands. The Semang (Negritos of the peninsula) or Pangan (short, round-headed, brachy to mesaticephalic, and woolly-haired, and with skin either chocolate or of a glossy black), live by hunting and by bartering jungle produce (honey, camphor, gutta, eaglewood, &c.), which they exchange with the Malays.

The Semang are in no way connected either with the Papuan or the African negro, both of which theories have been somewhat absurdly advanced. They wear fungus string girdles, dwell in temporary weather screens, round huts, or long communal shelters, which are furnished with bamboo sleeping platforms, and use the bow and arrow in place of the blow-pipe, except when in contact with Sakai. They eat practically "everything that is digestible" though there is no evidence that they ever were cannibals.

(2.) The Sakai of Perak, who are of medium height, light-skinned, long-headed, with wavy hair, and have much the best and most interesting features of all the Peninsula races. The Sakai wear porcupine quills through their noses, tattoo their faces, and use back combs with magical designs to ward off diseases. They employ the blow-pipe, in some instances a single length or internode (about 8 feet in length) of a particular kind of bamboo (*Bambusa wrayi* or *longinodis*), which is only known from one or two mountains in the Peninsula.

(3.) The Jakun, or "savage Malays" (*i.e.*, aboriginal Malayans), divided into land and sea tribes. Fairly pure Jakun occur on the Pahang Coast and Negri Sembilan, but elsewhere generally much modified by Negrito and Sakai elements. In fact, the Jakun taken as a whole are really a mixed group consisting of tribes partly aboriginal Malayan, partly Semang, and partly Sakai. The *pur-sang* Jakun, like the Malay, are of Mongolian origin. Their social organisation, which is of the Malayan type, is of a markedly higher order than that of either Negrito or Sakai. They perform mimetic dances accompanied by songs by way of representing birds, beasts, and other denizens of the forest, employ a peculiarly primitive kind of blow-pipe, have their marriages (of which the chasing of the bride by the bridegroom is an integral part) performed in presence of a peculiar artificial mound, and erect a diminutive soul-hut near the graves of their dead.

B.—The mixed races of Indo-China, a blend of the aborigines and the invaders, are as follows:—

(1.) The Cambodians or Khmers are taller than Annamese or Thai (1·65 m.), and are shorter-headed (brachycephalic) with (often) wavy hair, and eyes rarely oblique. Before the Annamese arrived, 200 years ago, they occupied the whole of Cochin-China. They have remained fairly savage, in spite of the beautiful monuments in their country.

(2.) The Annamese, who inhabit the Annamese coast, the delta in Tongkin, and most of Cochin China, with colonies in Cambodia, Laos, &c. They number from 15,000,000 to 17,000,000, and are in race akin especially to the Thai. They are short (1·58 m.), slender, short-headed, angular-faced with big cheek bones, and eyes slightly oblique. As a type they are very uniform. Their life is that of the Chinese. Socially, the village community, patriarchal family, and ancestor-worship form the foundation. Their Buddhism is superficial.

(3.) The Burmese (Mranma or Mramma), supposed to have come from south-east Tibet, and often referred to as a race of the Tibeto-Burman stock. They are a race of generally Mongolian character, but have straight eyes, and a warmer tint than the races to the east of them, and are more mercurial and artistic in temperament. They follow Buddhism in its purist form, and have long had elementary education. Arakanese is the most archaic dialect. They live in Upper Burma, Pegu, and Arakan, in a country part of which was occupied by the Mon (Talaings); the Arakanese differ slightly from true Burmese. They are short of stature and comparatively short-headed (mesaticephals).* Their language is toned.

(4.) The Thai were the latest to arrive. Their country is from the frontier of Burma Proper to Cambodia. In the north they are represented by races said to be allied to the races of Tongkin and China, and include certain tribes (of Tongkin and Southern China), the Shans (Upper Burma), the Laos, and Siamese. The Siamese are of medium height (1·61 m.), olive. One type has big cheek-bones, short flat nose, lozenge-shaped face. They speak a toned language, and are devoted Buddhists, and the most civilised of all the branches of their stock, having retained their independence in spite of severe pressure from neighbouring nations. In the Malay Peninsula they mix with the Malays; the mixed race resulting is called "Samsam," and represents some curious problems in race-fusion.

(5.) The Malays of the Peninsula (a specialised branch of Keane's "Oceanic Mongols") are an off-shoot of the South Mongolian stock; straight-haired (bluish-black coloured), almost beardless, with skin of a dark yellow brown or olive (or the colour of "newly-fallen leaves"); round-headed (brachycephalic), often with more or less flattened noses, somewhat thick ears, 1·61 m. in height. They are closely allied to the aboriginal Malay or Jakun race of the Peninsula (only, of course, where the latter approaches the pure type). They arrived in the Peninsula from Central Sumatra, where they were moulded by Indian influences into a more or less

* Mr. R. Grant Brown has kindly read the notes relating to the races of Burma.

civilised condition before they came over. When they arrived they found the country already occupied by the three pagan races (Negrito, Sakai, and Jakun), whom they drove before them into the jungle. It is thought besides, that at the time of their arrival they found the Mon-Khmer races occupying the same relation towards the pagan races (*i.e.* in possession of the coast line and points of vantage) as they (Malays themselves) do to-day, and that they partly absorbed the Mon-Khmer and partly drove them too into the jungle. This question, however, of the Mon-Khmer element in the Peninsula is still essentially an open one.

The Malays proper are but superficially civilised—a graft upon a savage stock. The natural savagery of their disposition continually threatens to break out, and not infrequently actually does so in the form of the *amok*, for instance, which was till the strong arm of British law made it too risky to indulge in and therefore unfashionable, the national Malay method of committing suicide. Another striking proof of the nervous excitability of their temperament is the strange disease called "latah." Apart from this tendency the Malay character has much in common with the Mongol, being under ordinary circumstances gentle, peaceable, quiet, civil, obedient, and loyal, but at the same time proud and sensitive to the point of honour, and with strangers especially suspicious and reserved. When free from the trammels of civilisation, the Malay is of a frankly bold and savage stamp, and makes an excellent soldier. He has been frequently charged with the sin of laziness. But although it is only natural that he should take life easily in a climate where the fruitful soil supplies with a minimum of exertion his simple wants, it is yet an open question whether this laziness is not largely due to the recent employment by his rulers of the "Krah," or system of forced labour, and also of slavery, which until quite late years rendered it impossible for the Malay labourer to reap the natural reward of his toil. Among the national institutions of the Malay race may be mentioned pile-dwellings, the blow-pipe and the Kris, the sarong, the filing and blackening of the teeth, the Balei, or council-house, and a strong belief in animism. Their traditions and romances contain references to human sacrifices, which appear to have been not long discontinued. They have mechanical skill of a high order, and are adepts in all crafts belonging to the jungle and the sea.

In spite of their being animists at heart the true Malays are frequently most fanatical Mohammedans, in contradistinction to the Battaks who are the hardest to convert. Their language is agglutinative, the roots as a rule being unchanged, and new words formed by means of affixes, infixes and reduplication. The roots are mostly dissyllabic, the derivations frequently very numerous, and the juxtaposition of consonants avoided, the most vocalic of all the dialects of the Peninsula being that of the Kelantan and Patani "Malays," which approaches in this respect the vocalic character of the dialects of the Pacific Islands.

Other Races Mentioned.

C.—(1). Java:—The Javanese are not of one uniform race, and may be divided into the Sundanese on the west, the Javanese in the east, the latter being mixed with "Hindu" (*sic*) elements. In the west of the island are the Baduj, and in the east part (Pasuruan) the Tenggerese, both heathen Indonesians of the savage type. The Madurese, Boyanese, and the Balinese resemble the Javanese. Java is of especial interest as the home of the Trinil, *Pithecanthropus erectus*, the upright ape-man, whose cranium is intermediate between the Neanderthal and Spy crania and that of the chimpanzee and hence the nearest link hitherto found between "ape-like men and men-like apes." It is significant that traditions of a strange man-like ape are widely current also in the Malay Peninsula.

It should be added that the magnificent sacred buildings of Java (*e.g.*, Brambanan and Borobudor) and Sumatra are of Indian type, and so with most of their culture. In Java especially the apostles of Indian culture had such success that their Javanese pupils became famous as musicians and as artificers in precious metals, even though these latter were not found in Java, and their ancient religion as well as that of the Malay Peninsula, is, although superficially Mohammedan (except in the Tengger and Padig districts) in point of fact, founded upon a Brahmanic or Hindu type overlying pure Shamanism. In Java the Hindu power was overthrown in 1478, after which Mohammedanism spread throughout the island.

In Java, inscriptions written in Kawi (the ancient Javanese language) survive from the eleventh or twelfth century, and it is evident from numerous archæological remains that Hinduism was introduced early, both in its Buddhistic and Brahmanical forms.

(2). Sumatra:—The northern extremity is peopled by the Achinese, Indonesians with Arabic admixture. In the south are the Palembangs (of Javanese origin), the Rejangs, described as Malayo-Javanese, the Passumahs, Indonesians with Javanese admixture, the Lampongs (or Passumahs crossed with Sundanese). On the west coast and its adjacent islands are races resembling the Battaks (*cf.* the Nias-Engano group), and off the eastern coast are mostly Malays. The cannibal Battaks are also Indonesians, good craftsmen, inventors of an alphabet and possessors of a literature.

(3). Borneo:—Malays on the coast, except the north-east, where are Sulus (Indonesians with Arabic admixture from the Sulu Islands), Bugis, Bajaus. In the central highlands, are tribes of Indonesian origin (Kalabits, Kahayans, Trina, &c.), that are in danger of being swamped by the tribes of the Kenyah-Kayan complex; in the north-eastern and north-western corners of Borneo, these Indonesian tribes (Dusuns, Muruts, Land-Dayaks) are in a more or less flourishing condition, as they have not been brought

into contact with more powerful immigrating tribes. The dominant Brachycephalic Sea-Dayaks may be regarded as Proto-Malays; their headquarters are the Batang Lupar and Saribas rivers of Sarawak, but their area of distribution is rapidly extending.*

(4). The Philippines are inhabited by the Negritos or Aetas ("Blacks") of the Interior, and a number of tribes of Indonesian origin, on the north-east Cagayane or Ibangs, the vicinity of Lake Cagayan in Luzon, and the Ifugaos (head-hunters): next the Igorrotes: next the Tagals; then the Mangianes (coast of Mindoro, east coast of Luzon, in the interior of the south, &c.). Then come the Ilocanos (west coast of Luzon), and also the Zambales and Pangasinanes of the south. The southern extremity of Luzon is inhabited by the Bicols (allied to the Tagals): West Mindanao is inhabited by Moros (fanatical Mohammedans, and pirates of mixed origin). East Mindanao is taken up by the Mandajas in the south, Bogobos in the north, and the Caragas tribe of Bisaya or Vissaya. Most of these last tribes are found in the rest of the Philippine Archipelago, north of Mindanao, and occur with Moros in Palawan. The Tagaloc dialect is spreading and superseding other dialects in the Archipelago.

WALTER W. SKEAT.

DISCUSSION.

The CHAIRMAN said that so many subjects had been touched upon by the author that he feared it was quite impossible for him to deal with more than a very few of them. It was difficult to pick out the points for discussion, because having been a Government official all his life he had been taught that he ought not to speak in public with reference to official matters, and nearly all the subjects of the paper had to do with politics of a sort. He also had in mind the unfortunate experience of another official, the Governor of Jamaica, who probably realised that it was a mistake to write; and though he (Sir Frank) was no longer a Government official and did not need to stand in great awe of the authorities, he could not even mention facts which were known to him, and it was very difficult to express an opinion upon them without giving some cause of offence. The paper dealt with a number of subjects which might be divided and classified into what this country had and what it had given away. The catalogue of our magnificent losses in the neighbourhood of the Malay Peninsula was something that he thought all present would take away and think about. At different times, Britishers had acquired for the country the practical control of Java, the North of Sumatra, the East Coast of Borneo, and Manila, which had been subsequently given up, not by the people who acquired them, who knew what they were worth, but by statesmen in this country, no doubt for excellent reasons if we only knew them. In exchange for islands which contained many millions of people and enormous undreamt of wealth, the Governor of Singapore, as Sir William had said, had now acquired a large number of high-sounding titles. For instance, he was the Governor of Cocos Island; he was the Consul-General of all that remained of Brunei, and also responsible for the Island of Labuan; but it was to be hoped that what had happened in the past would not occur again. This country had acquired a position in the Malay Peninsula, and it would be a great catastrophe if we were to lose it. The author had indicated what that position meant. Shortly stated it was that, by the foresight of one of the greatest English administrators, Sir Stamford Raffles, the British position was obtained at Singapore, and British influence and authority had gradually been extended up the Malay Peninsula. There was much yet that remained to be done. For instance, in his opinion the prosperity of Singapore was only just beginning, and it would be an appalling circumstance if anything were to happen which interfered with the proper interests of that place. It should be the aim of the authorities in the future to encourage every legitimate effort to continue the present successful policy. With regard to the work that had been accomplished in the Malay States, he desired to contrast that with the work done in other places. He had read in the newspapers that a certain amount of feeling had been developed in both India and Egypt against the authorities. He could say with the greatest confidence that that was not the case in the Malay States. If any agitator or foreigner were to go to the Malay States and endeavour to get the people to rise against the Government, he would find he had no listeners; in fact he had never in his life heard of either a foreign or native agitator in the Malay States. The people were entirely content and satisfied, and that he thought showed that something different had been done in regard to the administration of that tract of country from what had been done in other places. The actual rulers had been white men, who had endeavoured to better the condition of the natives of the place, and the best thing that could be said of the result was that the people were satisfied and did not feel that the white people were shutting them out; they did not feel that they were having taken from them something which was their birthright. The Government had given them more than they ever had before, and there was no feeling against the Government in any sense whatever. With regard to the social conditions of the States, he might speak on that extraordinarily interesting question, the Chinese, a question which, in this country, had had perhaps more than its real value attached to it; it had been used for purposes which he could not mention. But he understood that the subject of the Chinese in the Malay States was likely to attract the attention of the Imperial Government. There were

* I have to thank Mr. R. Shelford for these notes on the races of Borneo.—W.W.S.

people in this country who were so interested in the Chinese that they wanted them to give up what were called Chinese vices, such as indulgence in the eating and smoking of opium and the habit of gambling. Everything was a vice if indulged to in excess. Gambling existed everywhere. In that connection it must be remembered that the Chinese, who worked all day long, had no means of recreation whatever. The Chinese gambling haunt was not made particularly attractive, and there was nothing about it that would induce the natives to go there. In Europe, on the contrary, the gambling places were made extraordinarily attractive, and the most beautiful places in Europe were those where gambling was carried on to a degree of which a Chinaman never dreamed. Yet no one seemed to think that that was particularly offensive. He thought it was needless for people in this country to concern themselves about the Chinese miner, whose only form of amusement was to risk the money he had earned during the day in a gambling place, and probably lose it. With regard to the practice of opium eating and smoking, a Commission was appointed on that subject some years ago, and he thought the question was settled by the Commission. Nobody would dream of saying that to indulge to excess in the smoking or eating of opium was a good thing. There were many Chinese who did not smoke or eat opium to excess, and he had personally found they were quite as good members of society as people who drank, but did not drink to excess. He was sure all present had listened with the greatest possible interest to the excellent paper which had been read, and as it had been somewhat curtailed in delivery, he hoped they would take the opportunity of reading it *in extenso* when it appeared in the *Journal*.

Admiral the Hon. Sir EDMUND FREMANTLE, G.C.B., said that having had the pleasure of visiting the Malay States some years ago, when he was Commander-in-Chief in China, he felt bound to endorse all that the Chairman and the author had said as to the interesting States which were the subject of the paper. He remembered the Chairman kindly taking him over the gaol and various other public buildings at Perak, and he was very much struck with the fact that they were entirely up-to-date. When he compared them with the facilities which existed in Hong-kong at that time, the conclusion at which he arrived was that those in the State were at the top of the tree and the others near the bottom. The system of government was exceedingly well carried out, both in regard to the upkeep of the sanitary conditions and the supervision of the gambling. He believed he was correct in saying that everything possible was done in British colonies to stop gambling, but he was afraid the attempts were often unsuccessful. He remembered at one time, when some friends from England visited him, taking them round Hong-kong and showing them the Chinese gambling houses; and he was struck with the fact that, whether the Chinamen won or lost, they always paid up with a good spirit; they were extremely honest gamblers. With regard to the question of opium eating, he was assured by officers who commanded Sikh regiments that, almost to a man, they ate opium but in very small quantities; and that it would be as great, if not greater, punishment to stop their opium as it would be to stop an Englishman his beer. Nevertheless, the opium dens which he had seen in Hong-kong, Calcutta, and other places, were the most debasing spectacles imaginable; and in his opinion the effects of a drug like opium when used to excess were worse than the drinking of alcohol to excess. In many parts of the world he had seen British ideas carried out by British officers, not entirely in accordance with the strict regulations of the Colonial Office, but with marked success. The British public, as a general rule, were not aware of the state of things existing in the distant parts of the Empire; and it was useless for them to call a thing slavery or a brutality about which they had no idea, and to attempt to interfere in every detail of government. He hoped the people in this country would trust to the officials on the spot, and, bearing in mind that they were acquainted with the local conditions, believe that Englishmen, whether in distant parts of the world or at home, were full of those sentiments of humanity and justice which those present believed belonged to a great extent to the British race.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Sir William Treacher for his able and interesting paper.

Sir WILLIAM TREACHER, in acknowledging the vote of thanks, said he desired on behalf of the Council of the Society, and also on his own behalf, to express their deep thanks to Sir Frank Swettenham for so kindly presiding over the meeting at considerable personal inconvenience.

FIFTEENTH ORDINARY MEETING.

Wednesday, MARCH 20th, 1907; SIR JOSEPH WILSON SWAN, M.A., D.Sc., F.R.S., in the chair.

The following candidates were proposed for election as members of the Society:—

Aird, Mrs., 22, Eaton-square, S.W.
Charlier, Edgard, 19, Lerchenfeldstrasse, Munich, Bavaria, Germany.
Ghosh, Henry A., 9, Middle-road, Entally, Calcutta, India.
Griffin, John R., Kemble-street, Kingsway, W.C.
Khan, M. Habib ur Rahman, Habibganj, District Aligarh, India.

Mukharji, Sivnarayan, Uttarpara, near Calcutta, India.
Percival, Professor Hugh Melville, M.A., 14, Park-street, Calcutta, India.
Ransome, Ernest L., Westervelt-avenue, Tompkinsville, Staten Island, and 11, Broadway, New York City, U.S.A.
Reid, Hugh, D.L., J.P., M.Inst.C.E., Belmont, Springburn, Glasgow.
Reitlinger, Albert, 33, Fitzjohn's-avenue, N.W.
Wood, E. Escott, Hurricane-house, Brymbo, North Wales.
Woolner, A. C., M.A., Punjab University, Lahore, India.

The following candidates were balloted for and duly elected members of the Society:—

Cadell, Alan, C.S.I., Glenmara, Arthur-road, Wimbledon-park, S.W.
Conradi, Henry, 19, Ebbsfleet-road, Cricklewood, N.W.
Davies, Charles J., Milford Haven.
Fuller, George W., 170, Broadway, New York City, U.S.A.
Hayward, William Wyatt, 257 España, Lomas de Zamora, Buenos Ayres, Argentine Republic.
Midhut, Mohamed Hossain Khan, Office of Railway Board, Simla, and Zamania, Ghazipur District, U.P., India.
Myer, Reginald, 8, Ladbroke-square, W.
O'Brien, Hon. W. Turlough, 13, Egerton-place, S.W.
Ogilvie, Alec., 13, Holland-villas-road, Kensington, W.
Silberrad, Ch. A., B.A., B.Sc., care of Messrs. R. Silberrad and Son, 25, Savage-gardens, Crutched-friars, E.C., and Banda, U.P., India.
Testa, F. J., Honolulu, Hawaiian Islands.

The paper read was—

SMOKE PREVENTION IN FACTORIES AND ELECTRIC SUPPLY STATIONS.

By John B. C. Kershaw, F.I.C.

"Smoke prevention" is such a well-worn subject for papers and addresses, and has been so repeatedly discussed with, I regret to say, so little practical result, that I am well aware I am courting failure by adopting it as my subject to-night.

But the damage to health and property caused by smoke in the manufacturing and densely-populated centres of industry in this country is so enormous, and the gain to the community at large would be so great, if "smoke" could be banished from our towns and cities, that I feel justified in bringing the subject once again before the members of your Society, and through the medium of your *Journal*, before the larger public outside.

You will notice that my subject is, "Smoke Prevention in Factories and Electric Supply Stations."

I have purposely excluded the problem offered by *domestic smoke*, because this is entirely distinct in its character and method of solution from that of *factory smoke*, and in my opinion it will be most conducive to practical results to-night if we confine our attention to the one question: Is the smoke from factories and electric supply stations preventable?

While thus excluding domestic smoke from our consideration, I admit that in large towns and cities, and in the metropolis especially, the improvement of the atmosphere by the banishment of smoke is largely a question of the installation of gas-stoves and of other improved methods of heating for domestic purposes, and that this reform will have greater effect in clearing the skies than the smokeless combustion of fuel in factories. The aggregate amount of coal burned annually in London and in other cities of this country for purely domestic purposes is enormously greater than the amount burned in the same cities for manufacturing and similar operations, and the ordinary householder is a much larger contributor to the pall of smoke which covers him than he is aware. Like many another reformer, he is painfully awake to the shortcomings and defects of his neighbour's chimneys, while blissfully unconscious of the smuts produced by his own. But, while recognising that the smoke produced from factories and electric supply stations in London and in other cities of this country is only one-third or one-fourth of that produced by the ordinary householder, I do not agree with those who assert that on this account the prevention of factory smoke is entirely a secondary and unimportant matter. The evils produced by smoke are so great, and the pecuniary losses that arise from its emission are so large, that no factory owner or power station engineer ought to rest satisfied until he has done all that is possible to attain smokeless combustion of the fuel used for heating purposes in his own works. For the problem is not an insoluble one. I assert unhesitatingly, and not without knowledge of the difficulties of the situation, that the majority of factories and the majority of electrical supply stations located within the metropolitan area could even now carry on their operations without the emission of black smoke, if the heating and steam-

raising apparatus were properly designed and if the plant were placed under scientific control.

Why then has so little progress been made in this direction, and why is it the exception rather than the rule to find a factory or electric supply station in London with a clean record as regards smoke production? I answer because in the first place the plant has been badly designed, and because in the second place the owners and users are not sufficiently impressed with the necessity or advantages of altering it. Smoke prevention in the majority of factories and electric supply stations is, I again assert, at the present moment entirely possible and within the range of practical politics. I am therefore hopeful that as the information upon this subject increases, and fuel users are made to understand the practical advantages which result from the more scientific management of their heating or steam-raising plant, that chimneys belching forth clouds of evil-coloured vapour and black smoke will become a feature of the past. May we not also hope that as the knowledge of what can be and is being actually achieved in this matter spreads, we shall enter upon a new and cleaner epoch of industrial progress, in which manufacturers and station engineers will look upon a smokeless chimney as a *sine quâ non* of good management, and will feel it a personal insult when told that the chimneys of the works under their charge have been producing black smoke.

In this paper, then, I propose to describe briefly the principles underlying the methods by which fuel may be burned for heating and steam-raising purposes on a large scale without smoke-production, and to follow this with a short account of the organisation and work of a Smoke Abatement Society which is helping to spread this knowledge among fuel-users, and is assisting them in a most practical manner to attain the highest possible efficiency from their heating and steam-raising plant.

I.—The Principles of Smokeless Combustion.

Coal is a natural product which contains carbon, hydrogen, oxygen and nitrogen, in some form of physical state and chemical combination, which is not yet solved. For practical purposes, coal may be regarded, however, as a mixture of solid carbon and gaseous hydrocarbons, and it is the latter—namely, the hydrocarbon gases—methane, ethylene, acetylene and others of the same series, which cause the difficulty in burning coal without smoke.

The solid or fixed carbon unites with oxygen before it rises from the bars of the grate as carbon dioxide or carbon monoxide gas, and once in this form, it is never reduced within the furnace or flues to the solid state. The heat required to convert the molecule of fixed carbon into gaseous carbon, is also supplied by the combustion of the next lying molecule of fuel, and the combustion of the whole mass of fixed carbon is therefore progressive, and demands only two conditions—namely, an initial temperature of 700° C., and an adequate supply of air above and through the mass of glowing fuel.

The hydrocarbon gases given off by all fuels on heating, are much more troublesome to burn completely to carbon dioxide gas and aqueous vapour. These hydrocarbon gases vary from 6 per cent. in South Wales steam coal, to 35 per cent. in the bituminous coal from the northern coalfields, and the difficulty of obtaining smokeless combustion is therefore greatest with the cheaper and more generally used bituminous fuels. In the first place, the conversion of the solid carbon and hydrogen of the fuel into the gaseous state, demands a large amount of heat, and this heat is necessarily drawn from the solid fuel lying on the bars of the grate, and not from the burning gases.

A great reduction of temperature occurs therefore during the gasifying process, and unless the addition of fuel be wisely controlled, the temperature of the furnace may be brought so low that ignition of these gases fails to occur, and the gases are then simply distilled from the coal, and pass up the chimney unconsumed, as a brown and choking vapour.

These hydrocarbon gases, when escaping unconsumed at a low temperature, do not liberate soot, but they are deleterious to health, and their suppression on that account is certainly called for. Moreover, they represent a large proportion of the total heat value of the fuel, and their escape unburned is not conducive to the economical working of the plant.

Taking an ordinary bituminous fuel of the following composition: 70 per cent. coke, containing 10 per cent. ash and 60 per cent. fixed carbon, and 30 per cent. volatile matter; we find that the fixed carbon in each lb. of fuel burnt will produce 4,920 calories, while the volatile hydrocarbons will produce 2,859 calories, or 36 per cent. of the whole. To allow any portion of these gases to escape unburned is therefore a foolish waste of heat energy, and

yet it is one which occurs regularly at the moment of firing in badly-managed boiler plants, especially when an unskilled man is in charge of the boilers. For the complete and yet economical combustion of these hydrocarbon gases as they rise from the mass of fuel upon the bars of the grate, three conditions are essential, namely :

1. A temperature sufficiently high to cause the instant ignition of the gases. This is found by experiment to be about 670° C.

2. A sufficiency of air, preferably heated, to combine with the carbon and hydrogen of these gases, but not a large excess of the same.

3. A good admixture of the air and the hydrocarbons.

It is necessary not only that these conditions should be present initially, but that they should be maintained during the liberation of the hydrocarbon gases.

If the temperature be allowed to fall below 670° C., the gases will not ignite, while if the air supply be deficient, or if the admixture be bad, only partial combustion will occur, and solid particles of carbon will separate, which will later coalesce to form smuts and soot. The chemical changes which lead to smoke formation may be represented for practical purposes by the following equations, although Bone and Drugman have shown by recent researches that the changes are much more complex than was formerly supposed :—

$$2CH_4 + O_2 = C_2 + 2H_2 + 2H_2O.$$
Methane.

$$2C_2H_4 + O_2 = 2C_2 + 2H_2 + 2H_2O.$$
Ethylene.

$$2C_2H_2 + O_2 = 2C_2 + 2H_2O.$$
Acetylene.

Smoke is then caused, as a general rule, by failure to maintain conditions 2 and 3 of perfect combustion. When smoke is once formed, it is not possible on a large scale to secure its combustion, and only some form of smoke-washing apparatus will remove it from the chimney gases.

All the so-called "smoke-consuming" appliances are, therefore, mere devices to secure more perfect combustion of the hydrocarbon gases at the moment of their liberation, and in nine cases out of ten, they do not involve any novelty of principle or of construction.

II.—Practical Methods for Smoke Prevention.

The facts given in the preceding section of this paper show that the smoke problem is one which chiefly relates to the use of bituminous fuel, and that the perfect combustion of the other classes of fuels, liberating less than 15 per cent. of volatile hydrocarbon gases on heating, is not a difficult matter.

The furnaces originally designed and installed for boilers will, as a general rule, maintain the three conditions essential for perfect combustion with such fuels, and it is for this reason that in many of the London generating stations the high-priced South Wales steam coal is being used for steam-raising purposes, with notable effect upon the costs of supply.

The considerations advanced in Section I. however show, that bituminous fuel requires, for its perfect combustion, a large brick-lined chamber maintained at a temperature of from 700° to 1,000° C., in which the hydrocarbon gases and the heated air can mix thoroughly, and burn to CO_2 and H_2O, before they are allowed to come into contact with the water-cooled plates or tubes of the boiler. The size of this chamber must be proportioned to the volume of hydrocarbon gases liberated by the fuel, and therefore the character of the fuel supply ought to be taken into consideration when designing and erecting the boiler plant. If the furnace is to be hand-fired, some automatic device is also necessary whereby the draft is almost entirely cut off while the furnace door is opened for clinkering and firing purposes. When the firing is finished and the furnace door is closed, some mechanical device is again required for regulating the volume of air admission above the fire, and the period for which this secondary air admission occurs. Mechanical stokers with automatic and regular or continuous feed, obviate this difficulty of an intermittent secondary air supply, and it is for this reason that they have become so popular in large steam-generating plants. Finally, with all systems of firing, the complete combustion of bituminous fuel demands some device, for thoroughly mixing the heated air and hydrocarbon gases in the combustion chamber.

It is not my intention in this paper to give further descriptions of the methods by which bituminous fuels may be burned without smoke emission, and with high efficiency, in the furnaces of steam boilers and of heating apparatus generally. There are a large number of patented appliances and devices for attaining smokeless combustion now on the market. In so far as these embrace the features that have just been described, they may be held to be useful, though the validity

of the patents may in many cases be doubted. I have no hesitation in stating, however, that where these appliances are in use, though only relating to the maintenance of one of the three essential conditions, the emission of black smoke has been greatly curtailed if not altogether stopped.

A plant designed and erected in accordance with the whole of the practical recommendations given above, would be capable of burning the cheapest types of bituminous fuel with high efficiency, and with absolute smokelessness. I am hopeful that at a not very distant date I may be able to point to many such steam-generating plants in this country.

III.—The Organisation, Aims and Work of the Hamburg Smoke Abatement Society.

Two of the chief difficulties confronting the factory owner or station superintendent, desirous of improving the work of his heating or steam-raising plant, are those arising from lack of expert aid in its control and the scarcity of competent firemen. In large works, a specially trained chemist or engineer is sometimes given the sole charge of the boiler-plant with notable results as regards smoke abatement and economy, but in small works this plan is of course impracticable.

As regards the supply of competent firemen, this has always been deficient, and I have no hesitation in stating that a very large proportion of the smoke produced in this country is due to the low class of unskilled and untrained labour employed for firing the heating and boiler installations.

The Hamburg Smoke Abatement Society is a voluntary association of steam-users with works in or near to the city of Hamburg, which was formed in October, 1902, for the purpose of assisting its members in the better management of their steam-raising plant. The work of this society lies chiefly in the two directions indicated above. In the first place, a staff of engineers with special experience in boiler management is retained by the society, and these advise and report upon the boiler installations of its members. Special steam-raising tests are carried out at regular intervals of time, and every effort is made to bring each boiler installation up to a high level as regards smokelessness and efficiency. This solves the difficulty of "expert aid" for the small steam user.

In the second place, the society retains the services of two or more firemen instructors—these visit the different works of the members of the society, as desired, and carry out a course of instruction for the firemen employed. In this way a body of competent firemen has been created in the city of Hamburg, upon which the members of the Smoke Abatement Society can depend for efficient stoking of their boiler plants.*

A third direction, in which the Hamburg Society carries out most useful work, is in testing and reporting upon the value of new smoke abatement appliances or systems of firing. The society possesses a small model steam-raising installation where these trials can be carried out under the supervision of its own staff of firemen and engineers, and the reports upon these trials, issued to its members, form another valuable feature of its activities. Further information about the work of this society will be found in a paper contributed to the Conference on Smoke Abatement, held in London in 1905, and I may perhaps be allowed to quote here the concluding paragraph of that paper.—

"The practical lesson which we in this country may learn from the above account of the work of the Hamburg Society is, I think, that the smoke problem is to be solved, like many another problem, by application of that old English method of self-help, which is now sadly out of fashion. Manufacturers, and fuel-raisers generally, in this country, must be taught that the emission of black smoke is largely preventable, and that the smokeless combustion of fuel promotes economy, when carried out under proper supervision. It is for this reason that I have given instances from the annual reports of the Hamburg Society to prove the saving in fuel-consumption, which results from the working of steam-boiler plants on scientific lines, with properly trained stokers.

"What is wanted in this country, is some society or organisation which will provide fuel-users with the technical advice and oversight required for obtaining the smokeless combustion of fuel in their own works. The Hamburg Society, in my opinion, is such an organisation, since it is showing manufacturers how to combine together to attack the evil at its source—namely, the boiler and heating installations in their own works. It would be well if similar societies were started in every large centre of manufacturing industry in this country."

IV.—Conclusions.

I shall not be surprised if I am told in the course of the discussion which is to

* The London Smoke Abatement Society has recently commenced a similar work, and has appointed Mr. William H. Booth its official Lecturer. A course of lectures to Stokers is now being given by this gentleman at the Borough Polytechnic.

follow the reading of this paper, that I have advanced no new theory to account for factory smoke, and have proposed no new plan or remedies for securing its abatement. This is perfectly true, more true perhaps than some of my critics themselves realise. The principles of smokeless combustion enunciated in this paper were first put forward by C. Wye Williams, a Liverpool engineer, in the year 1839, and the following extracts from Williams's book entitled "The Combustion of Coal," will prove to you that he had a fairly correct knowledge of what was required to secure smoke abatement:—

"It may be asked how it has happened that hitherto this (the smokeless combustion of fuel) has not been effected? I answer because the chemistry of combustion has been neglected, not in the laboratory, but in practice; and because the construction of our furnaces has been too much left to those who know little of the chemical properties of the materials which are consumed in them. . . . . ."

"A charge of fresh coal thrown on a furnace already in an active state, so far from augmenting the general temperature, or giving out heat, becomes at once an absorbent of it. . . . . ."

"I have proved during the last fifteen years, that even in the largest establishments, and in the furnaces of steam boilers, the great nuisance of smoke may be avoided, and even with the accompaniment of considerable economy. . . . . ."

"In marine and cylindrical land boilers the combustion chamber is invariably made too shallow and too restricted."

Williams clearly pointed out that the combustion of bituminous fuel involved two distinct things, namely, the liberation and combustion of the volatile gases in a suitable chamber, and the combustion of the solid coke on the bars of the grate. In one place he described how he proposed to put into practice these principles of fuel combustion, and showed drawings of boiler furnaces with properly designed and scientific arrangements for providing a secondary and heated air-supply behind the bridge. He was very sarcastic at the expense of inventors, who, even in his day, were patenting devices for "consuming smoke," instead of attempting to show how to prevent its original formation.

The above extracts prove that this was altogether a remarkable book to have been written and published nearly sixty-eight years ago.

Williams's book was re-printed in 1854 and 1886, but its teaching appears to have had little effect upon the practice of boiler engineers, who still persisted in designing and erecting boilers with wholly inadequate combustion space for the class of coal that was burned.

The results of trials carried out by the Manchester Association for the Prevention of Steam-Boiler Explosions in 1867-68, were similarly ignored by boiler-makers and their users, for here again it was proved conclusively that the bituminous fuels of the Wigan coal-field could be burned with high evaporative efficiency and without smoke emission under steam boilers, if proper attention were given to the design of the furnace, and to the control of the firemen and of the draught. The methods of attaining comparatively smokeless combustion and an evaporative efficiency of 9½lbs. of water per lb. of fuel, in these Wigan trials, were practically those recommended by Williams 29 years earlier, and the chief novelty of Mr. Fletcher's report is the insistance upon the need for good stoking. In his opinion stoking was an art, and should be treated as such, "and not as a slap-dash random process, which any untaught labourer could accomplish."*

The information I have placed before you to-night in my paper, is then merely a restatement, in more scientific form, of the principles and practical recommendations contained in the writings of engineers, who were studying and experimenting upon this subject during the mid-Victorian era. Is it therefore valueless as a practical contribution to the problem of smoke abatement? I think not. There is an altogether mistaken notion abroad that some new theory of combustion or some startlingly new form of steam generator is required before we can hope to reduce the emission of smoke in our factories and centres of manufacturing industry. No greater fallacy has ever entered the minds of engineers, and hindered progress towards reform.

If the principles and methods described by Williams and Fletcher half a century ago, and redescribed by myself in this paper, are recognised and properly carried out, bituminous fuel of the cheapest type can be burned to-day without smoke emission.

The clouds of black smoke which hang about and float away in inky streams from the chimneys of more than half the factories and electric supply stations in this land, are therefore simply an indication of the indifference or ignorance of the engineers who designed and supplied the heating and steam-raising plant.

* William H. Booth in London), F. J. Rowan (in Glasgow), and A. Bement (in America) have since this period been advocating these principles in the technical press.

With a properly designed plant, placed under expert control and manned by properly trained and skilled firemen, smokeless combustion is an assured consequence.

I therefore say that the production of smoke in the cases to which my paper refers is not only a waste of fuel, but is an unnecessary evil, and that it is an anachronism which reflects sadly upon our national want of thoroughness in the application of scientific principles to industrial practice.

DISCUSSION.

The CHAIRMAN, in opening the discussion, was sure all present would agree that the subject was a very important one. He wished, however, the scope of the paper had been wider, for, as the author said, the prevention of smoke in connection with steam raising would merely be a mitigation, to a comparatively small extent, of the evil of general smoke production. It would be acknowledged by all that the author's arguments that every means should be adopted to prevent the production of smoke in cunnection with steam raising were undeniable. He was sorry Mr. Kershaw thought so ill of electric light stations, because he (the Chairman) had hoped that they enjoyed a tolerably good character in regard to smoke production. He did not mean that the entire number of electric light stations, new and old, were equally emaculate, but a very large proportion, especially of the newer and larger stations, deserved some credit for the extent to which they had rid themselves of the opprobrium of smoke production. It was, he agreed, a scandalous thing that, in connection with the production of electricity by refined scientific processes and exquisite machinery, there should be joined the barbarism of smoke production; it was an inconsistency that should not continue. Consideration should perhaps be given to exceptional cases, particularly earlier stations where the site was not well chosen, where the space was a cramped one, and where allowance had not been made for the quantity of power that would be required; but he knew of stations which were very free from any gronnd of complaint on account of smoke production. The author of the paper had been most moderate in his claims; he entirely disclaimed originality in connection with his proposals; but it was by no means a useless thing even to read the Commandments. What Mr. Kershaw had put forward in the paper was very sound science, and he was sure the audience were deeply indebted to him for it.

Mr. RUDOLPH GRUNHUT thought the cause of smoke was often due to the fact that the flues were too small. If bituminous fuel was used the chimneys ought to be designed 10 to 20 per cent. larger than where best Welsh coal was consumed. He had lived for some years in Germany, especially in the industrial district of Düsseldorf, where smoke was practically non-existent owing to the attitude taken up by the authorities. It was possible to prevent smoke, especially where Welsh, Durham, or Yorkshire coal were used. Bituminous coal from Bohemia, which was largely used in Berlin and the surrounding districts, did not create any smoke because the chimneys were large enough. It was found as a rule in this country that the chimneys were not sufficiently high, very few engineers designing chimneys on scientific principles. The great fault was that chimneys were built of about the same diameter at the top and bottom, whereas they ought to be wider at the bottom, because the gases were there hotter and consequently occupied a bigger volume. The present model building laws, which were made in 1812, when chimneys were built very low, and when no big plants existed, were much at fault. That old law made chimney building very expensive, and chimneys were not usually built on scientific principles.

Mr. WALTER REID remarked that the author did not recommend any definite system of preventing the production of smoke, even from coals that were not very bituminous. Very great advance had been made in recent years in the design of plant, the use of automatic stokers being very general. At the St. Louis Exhibition, of 1904 he saw an excellent plant, which produced thousands and thousands of horse-power, and very large quantities of electricity from coal which was not touched from the time it was hewn in the mine, till the time it was consumed. The question whether the firing was intermittent, or the furnace was kept continually hot made a very great difference, and that ought to be considered in the by-laws relating to the subject. Considerable injustice was sometimes done to factories and electric light stations by local authorities in this country, who made no allowance at all for the difficulty of firing up at the beginning of the heating period without any smoke. In France, a certain number of minutes was allowed to get up a heat sufficient to avoid smoke, and after that period smokelessness was the rule. In Germany, the principle was applied in a different way, a certain amount of noxious gases being allowed to be emitted in the course of twenty-four hours. In this country, the gases were allowed to be diluted with air. Manufacturers could practically turn out into the air as much noxious gas as they liked, provided it was diluted below a certain point; but in Germany the total amount of noxious gas that might be emitted was limited, while they did not limit the amount that was to be turned out per cubic metre of gas. He desired to take the opportunity of expressing regret that the firing of large boilers in great power stations was dealt with on such very narrow lines. Inventors were continually inventing new fire bars and new furnaces, but they did not tackle the subject on

broad lines. For instance, in the cement industry enormous quantities of fuel were burned which would otherwise produce a great deal of smoke, but by burning them in rotary kilns an absolutely white smoke was obtained, which chiefly consisted of the fumes from the materials used in the production of the cement and not from the fuel. The fuel in a rotary kiln, if well-handled, produced no black smoke at all. Why such a thing should not be possible with a boiler it was difficult to understand; it was only a question of original design based on the well-known governing laws. One point which the author had not referred to as fully as it might have been was the production of producer gas. There was a slight loss of fuel and efficiency in the production of gas, but, on the other hand, the gain was very great. As the market stood at present, the gain from the by-products was infinitely greater than any loss in the heating efficiency of the fuel. A large Mond gas installation was very remunerative with regard to its by-products; and the whole of the fuel put into such an apparatus could be utilised without producing any black smoke, while at the same time products were recovered which might otherwise go into the atmosphere and pollute it. It must not be considered that because the emission of black smoke into the atmosphere was stopped, that thereby all the impurities which went into the atmosphere were eliminated, because there was always a percentage of sulphur in fuels which went into the air and polluted the atmosphere. The whole key to the prevention or diminution of smoke was the fuller utilisation of the energy contained in the fuel, beeause the more fuel that was burned, naturally the more impurities went into the atmosphere.

Mr. JAMES N. SHOOLBRED said the question of perfect combustion in fuel had been greatly discussed, but it did not make much progress. Appareutly the most ideal method of consumption of fuel was that provided by a very good self-stoking apparatus, but it would be admitted that that was not sufficient. The check in the admission of air to the fuel was very good, but its admission to the chimney had also to be considered, and there the best check to its too rapid progress was a fuel economiser. That was very good arrangement for making use of the heat of the smoke that remained, and so reducing its temperature before admission to the chimney. Another point which was lost sight of was the fact that it reduced the speed, and prevented the smoke from getting too soon into the chimney by the excess of draught carrying with it a quantity of the soot which otherwise was deposited. He quite agreed with Mr. Grunhut as to the necessity for designing the chimney not only for the requirements of the horse-power, but of the particular fuel to be used. In designing a chimney many people seemed to think that the superficial area of the smoke stack was of great importance, but it was the cubical contents of the chimney which were the primary consideration, because the draught was increased or diminished according to the height of the chimney. The cubical contents per horse-power required out of the boiler was the important factor. After consulting many authorities on the subject and as a result of his observations, he found that from three-quarters of a cubic foot to one cubic foot per indicated horse-power was a fair amount to allow with ordinary coal. The temperature at which smoke was allowed to enter the chimney should not be much over 400° F., if it was higher it produced a draught, and where the draught was excessive black smoke resulted. The late Mr. F. W. Webb, of Crewe, introduced rather a novel test for his stokers; he inserted every week a log of pinewood in the chimneys of the engines, and if that was found to be seriously charred at the end of the week the stoker was fined, because he had induced too great a draught, caused probably by the doors of the chimney being opened too often. That rule had had very beneficial effects, at the Crewe Works, in economy in the consumption of fuel, and in the reduction of thewaste into the air. With regard to the remark made about stoking being an art, stokers themselves admitted that the mode in which they stoked made all the difference in the results. He did not know whether the author would bear him out in the remark that self-stoking apparatuses were not so much in favour as they were 20 or 30 years ago, when there was a regular rush for them everywhere. So many disappointments occurred at that time that he fancied a great many of the more recent works were not so ready to adopt any of the numerous patents that were then taken out.

Mr. W. M. MORDEY stated that the author, in explaining the action that took place in the furnace, said that in certain conditions of combustion, hydro-carbon gases passed as a dark brown vapour up the chimney. Was it not the fact that if there were only hydro-carbon gas there would be very little gas smoke? Reference had been made to the difficulties which arose owing to the variation of conditions. The author had given electric light stations due credit for the very difficult conditions under which they had to work. Electric light stations complained of small load factors and very high peaks, which rapidly rose and fell again. Those were conditions as regard smoke prevention which were more difficult than factory conditions, where the load was nearly steady for many hours a day. He agreed with the author that if smoke was formed it must probably be washed; but unfortunately with steam boilers washing meant cooling, and that involved loss of draught. Therefore unless the washing was done at the top of the chimney, it meant providing some other way of getting a draught. The real cure for smoke production was that suggested by one of the speakers, namely, the obtaining of power by gas instead of by steam, and that was bound to come sooner or later. The rivalry between the two was very old, but the issue was cer-

ain. At the present time, with all the steam-raising economical devices and every improvement that could be thonght of in steam plant, only 15 per cent. economy was obtainable, whereas a gas engine could be obtained, without specifying anything in the way of economy, which produced 23 per cent. or 24 per cent. efficiency, and that figure could be increased several per cent. if pains were taken. Although the day of the steam engine and the steam boiler was not over, it would certainly be displaced before many years had passed. He did not think there was a steam-driven station in or near London to-day which had succeeded in giving its customers 4 per cent. of the total energy of the coal consumed; and its importance lay in the fact that the coalfields of this country, at the present rate of output, would approach exhaustion in about 150 years. It must be remembered that the losses were not in the electrical part of the plant or the transmission, as they took place before the transformation into electrical energy He quite agreed with the remark that if smoke were prevented in connection with factories, that would only be a partial cure, because the great sinner in most towns was the open domestic fire. Gas fires, however, were slowly displacing coal fires with very good effects. Gas producers were now being largely used, especially for small industries, and in those cases practically no smoke existed. He did not gather it was suggested that Mond or other gas should be used for firing boilers, because it was fairly well admitted that such gas could not, under most conditions, be used economically in competition with ordinary direct firing.

Dr. H. A. DES VŒUX, after giving particulars of the inception and subsequent working of the Coal Smoke Abatement Society, stated that anyone who had lived in London twenty years or more, could bear testimony to the enormous difference which had been produced in the atmosphere in the last few years; and he had the greatest pleasure in saying that there had been no greater change in any factory in London than there had been in the electric light stations, the smoke from which had been reduced at least 90 per cent. in the last few years. His argument that the smoke from the factories in London had been very much reduced was borne out by the figures published by the Meteorological authorities of the number of days of fog in London, they having been reduced from an average of between 50 and 60 to between 20 and 30 three or four years ago, to 12 the year before last, and according to his own observation to only four last year. About 18 months ago the Coal Smoke Abatement Society sent 72 circular letters to some of the manufactories and electric light stations in London, which had been former offenders against the Smoke Act. Forty-two replies were received, only one of which said that the smokeless combustion of coal had cost them any extra money; thirty-eight said it was an economy, and the remaining two or three said it made no difference in expense. After a great deal of trouble, the Society had started a class for training stokers, which was under the very able superintendence of Mr. Booth, and was attended by over ninety students. That was the first class which had been instituted for the training of the ordinary stoker, and showed what a blank existed in regard to the technical instruction of men who should be partially scientific instead of purely manual labourers. The Education Committee of the London County Council was now being communicated with, in the hope that they would establish similar classes all over London; so that manufacturers would not be able to grumble in the future that they could not obtain properly trained stokers. In reply to the circular which was sent out, the manufacturers also said that, on the whole, they thought efficient hand-stoking was better than mechanical stoking, and that even if mechanical stokers were used trained stokers was also required, while others said they had supplanted their mechanical stokers by manual labour. The Coal Smoke Abatement Society had also endeavoured to start a society in London on the lines of the Hamburg Society, but so far unsuccessfully, probably because there were no engineers connected with the society. They had endeavoured to interest engineers in the subject, but for the last eight years had had to work without an engineer on the committee.

Lieut.-Col. ALLAN CUNNINGHAM, R.E., desired to re-inforce the remarks which had been made as to the improvement in the climate of London. His memory carried him back 55 years ago, when factories used to freely emit large volumes of black smoke; but things had very much changed since then. A great change had taken place in the climate of London. Fifty-five years ago a London fog was of a yellow colour, at the level of the street; it was of an intensely acrid character, and entirely stopped traffic. While the black smoke emitted by factories had decreased, there had been a vast increase in the amount of smoke sent out by domestic chimneys, and that had caused a change from the yellow fog of old days to the black gloom overhead of which the London fog now consisted.

Dr. OWENS inquired whether the author had any data as to the percentage of fuel which was lost in solid carbon from factory chimneys, and in tar and unburnt hydrocarbon gases? He believed that the loss from domestic grates sometimes approached 5 per cent. of the total weight of the fuel burned; but he knew that in factory chimneys and well-fired furnaces the losses were not more than about one-third per cent. There could be no doubt as to the diminution that had taken place in the number of fogs, and further than that, the drop occurred in the year 1900, the very year that the Coal Smoke Abatement Society commenced its work. He did not wish to criticise anything the author had said as to the principles of

combustion, but thought the problem should be looked to as a whole and not in part. It was useless only to consider factories, because the solution for them might leave unsolved the solution to the other part. If a solution was to be looked for in the form of gas delivered into large cities, that would do away entirely with the production of steam in boilers.

Dr. SCOTT TEBB stated that he was analyst to one of the metropolitan boroughs, aud that in his experience there did not seem to be in recent years any diminution in the number of complaints with regard to smoke brought to the notice of the Council. He desired to raise the point whether the diminution in the fogs of London was altogether concerned with the question of coal or smoke. It seemed to him that meteorological conditions might exist in connection with the mistiness of the air which might produce the fogs.

Mr. WALTER C. HANCOCK emphasised the last speaker's remarks that it was necessary to take into consideration, in connection with the question of the reduction in the number of fogs in London, any changes which might have taken place in the meteorological conditions that had prevailed in London during past years. The reduction in the number of fogs had extended over a small period, and it was hardly safe to draw inferences from the results of a few years. The fact that there had been such a rapid advance in the application of gas and electricity of recent years must be taken into consideration in dealing with the question, while the humidity of the atmosphere was also a very important factor. He also agreed with the statement that the question must be considered as a whole, and that the most important factor in the creation of smoke in large cities, was the domestic chimneys. There was no doubt as to the economy to be obtained in the smoke production of an ordinary factory chimney by the proper construction of the chimney, by the regulation of the air, by mechanical stoking, and the introduction of economisers.

Mr. F. H. SMITH suggested that the question of the relative merits of mechanical and hand stoking depended entirely on the quality of coal used. One speaker had suggested that, in order to avoid smoke, a very important point to take into consideration was the design of the chimney, and he went on to argue that the cubic contents of the chimney was the important consideration. In his opinion, it did not depend on the cubical contents of the chimney.

Mr. KERSHAW, in reply, stated that the first speaker emphasised in the remarks he made with regard to the width and height of the chimney and the design of the plant generally adopted in Germany what he himself had stated in the paper, that the design of the plant and especially the size of the furnace, the boiler, and the combustion chamber ought to be carried out in view of the kind of fuel that was to be burnt. As a rule, plant was planked down without any reference to the coal that was to be burnt in it, and in nine cases out of ten difficulties arose because the combustion chamber was too small, while on other occasions bituminous fuel was burnt instead of Welsh coal. The remarks made supported his own view, that bad design of plant was in many cases the cause of the trouble. With regard to the question of draught, he thought it would be found in the best generating stations that induced or artificial draught was used in place of natural draught, which gave greater command over the work which could be obtained. If artificial draught was used in electric light plant, it was possible to adapt the plant to the lead on that station, whereas if natural draught was employed the engineer was handicapped. Mr. Reid, who agreed with most of the principles laid down in the paper, had rather quarrelled with him because he had not given more details as to the practical applications of the principles advocated. His reasons for not doing so were obvious. There were hundreds of patented applications of the principles on the market, in the validity of which he did not much believe, but it would have been impossible for him to describe them all in the space at his disposal. He, therefore, thought it much safer just to describe the general principles, and to treat the application of them in the way he had done, rather than by describing particular patents. Mr. Reid also referred to the use of coal-dust for firing cement works. The Schwartzkop coal system had been applied to the firing of boilers, and another system was also being used, which had not been generally adopted because of the great difficulty of grinding the coal. The whole of the district round about where the system was used was plastered with coal dust; and for that reason he believed coal dust firing had not advanced much, although it solved the difficulties which had arisen. Gas had been applied to boiler firing as a kind of intermediate stage. At one place a Mond gas plant was put down some years ago, the gas being used for firing the boilers; a complete transformation had now taken place, gas plant alone being used. Gas firing could be applied, and did, to some extent, overcome the difficulties experienced. Mr. Shoolbred, who dealt with the defects of mechanical stokers and the need for economisers, did not mention one great difficulty with mechanical stokers, viz., that where travelling chain grate stokers were used, the back of the grate became choked up with unburnt coal, a great deal of the fuel being lost, or open spaces were left through which a lot of air entered. Personally he believed that mechanical stokers, when well managed by a good stoker, did give high efficiency, but it was a question of management. He thought that Mr. Mordey, who asked a question about the hydrocarbon gases, was in error in stating that if they were in a pure state they would not be colourless. Hydro-

carbon gases in the pure state were colourless, but as they were generated from coal they were mixed with tarry vapours which gave them a colour. Mr. Mordey was also incorrect in thinking that the colour could be entirely got rid of if the solid particles were washed out. From the results of his own observations in testing a large number of coals, he did not think that colour was due to solid particles. He quite agreed with Mr. Mordey that ultimately gas engines would be generally adopted; their efficiency was so much higher, that there seemed to be no reason why that should not be so, but it would be a very long time before it would be possible to scrap all the steam generating plant in this country, and substitute gas engines for it. His paper dealt with things as they existed at present, and how smoke that was produced by steam-generating plant could be prevented. As a member of the London Smoke Abatement Society, he was greatly interested in the work it had done, and was glad to hear from Dr. Des Voeux that so much of the improvement in the atmosphere of London was due to their work. Colonel Cunningham had referred to the improvement in the atmosphere of London in the last fifty years, but other speakers seemed to think it had not improved so much as Colonel Cunningham thought. There was not much definite data available with regard to the fuel actually lost in smoke and hydrocarbon gas escaping from factory chimneys. He thought it was a good deal more than the one-third per cent. estimated by Dr. Owens, but he was sorry he could not give actual figures. Wherever black smoke occurred, bad conditions of combustion existed which led to the loss mentioned, the amount of heat lost amounting possibly to 30 or 40 per cent. of the total heat value of the fuel. In conclusion, he desired on behalf of the audience and himself to thank Sir Joseph Swan for so kindly presiding over the meeting.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Kershaw for his interesting paper, said he was exceedingly gratified that so many of the speakers had testified to the improvement which had taken place in regard to the non-production of smoke at electric light stations. It must not be forgotten that the electrical engineer had to labour under considerable difficulties in connection with the production of power for the generation of electricity, owing to the irregularity of the demand. Sometimes he had to maintain boilers under steam when there was no demand, while at other times he was suddenly called upon to develop a large amount of power. If any of the proposed great schemes for the generation of electricity, more particularly with a view to the production of power in place of steam, were ever carried out, as he had no doubt they would be, they would constitute a very important contribution to the means of further abating smoke arising from works not only in connection with the generation of electricity for lighting, but also through the substitution of the steam engine by electrically produced power, and the equalising of the demand.

The resolution of thanks having been carried unanimously, the meeting terminated.

FRENCH CIDER PRODUCTION.

The manufacture of cider in France has assumed enormous proportions, and in some parts of the country, especially in the north, its consumption exceeds that of wine. It appears that the cider production of 1906 amounted to 477 million gallons, against 88 millions in 1905. It used to be said that the cider output was usually about one-fifth that of wine, but in 1906 it was considerably more than a third. The American Consul at Bordeaux says that while there are over eighty varieties of apples grown, he finds that but thirteen of them are ever used for making cider. These are the "Marin," "Onfroy," "Grosbois," "Bedan," "Blanc Mollet," "Railé," "Fréquin Blanc," "Fréquin Rouge," "Jaune et Pointu," "St. Laurent," "Martin Tessart," "Prune de Miel," and "Argile." It is said that sweet apples make a flat cider, difficult to keep, and lacking in alcohol. Cider made from bitter apples is poor, thick and astringent, and sour apples make an acid cider which is considered injurious to the digestive organs. The best apples for cider making are those which contain sufficient sugar and tannin, and which have a pleasant fragrance. These qualities, the varieties named, especially the first three, possess in a remarkable degree. Many of the manufacturers claim that a mixture of one-third of sweet apples to two-thirds of bitter and sour apples makes the ideal cider. The apples are gathered only during fine weather. They are shaken from the trees and caught in nets to prevent bruising or contact with the ground. If they are not carried immediately to the press they are placed in dry lofts where there is a good circulation of air ready for use. The idea that fermentation purges of all impurities is not believed in France, at least so far as cider making is concerned. No green, decayed, or worm-eaten apples are ever used. The fruit must be clean, for even a little particle of earth, it is asserted, will produce a chemical action that is highly injurious. The fruit is first put through a cutter, the pulp and juice collected in a vat and exposed to the air for about fifteen hours, being stirred from time to time. The pulp is then put in the press, in layers of from four to six inches, separated by light rush screens, and the juice extracted. At this first pressing, the best of the modern presses (the old cumbrous affairs having almost entirely disappeared), give no more than 65 to 70 per cent. of pure juice. The "must" from the first pressing is placed in a vat, warm water being added to the extent of 25 to 30 per cent. of its volume. It is left to macerate for about fifteen hours and then pressed a second time. To the remaining must there

are added ten gallons of water to every hundred pounds, and then comes the third pressing. One hundred pounds of apples are said to yield of first quality pure cider, 60 to 70 pounds; of second quality cider, 25 to 28 pounds, and of third quality cider, 25 to 28 pounds. In some places cider is made by the method of diffusion, which consists of macerating finely chopped apples for twenty-four hours with an equal quantity of water. The process is repeated three times, but it has been said that the results are not nearly so satisfactory as the method previously indicated. Cider is fermented in closed apartments with a temperature of from 54° to 65° Fahrenheit. The casks in which it is to ferment are thoroughly cleansed, and the sulphur wick is burned in them. In the fermentation, the lighter substances called the "chapeau," rise to the surface, and the heavier—the lees, which are thick and sticky—fall to the bottom. Between the two is the pure cider. If the fermentation is not sufficiently active it is usually increased by taking out and heating one-fourth of the contents of the cask and then pouring back over the rest. After fermentation (in from four to five days, if the temperature is moderate, a little later if cold), the cider is drawn off carefully into sulphured casks, which are always kept well filled. Two months later it is again racked, and six weeks later drawn off for the third time. The liquid is then generally perfectly clear, but if not it is clarified with about two ounces of tannin for every hectolitre (22 imperial gallons). Cider is best preserved in cool, dry cellars, and in bottles better than in casks. Thick champagne bottles are always used, and the corks are tied with twine. Rubber stoppers are never used for cider bottles. If bottled fresh the cider becomes sparkling. If it is found to be slightly acid, a little candied sugar is added to each bottle. Three months afterwards the cider becomes excellent. Cider frequently turns bad, especially if every stage of its manufacture has not been well looked after, and carefully done. Among the principal "maladies" to which cider is subject may be mentioned the "Fleur du cidre." This is a sort of white veil floating in the cider. As soon as it is noticed the liquid is drawn off into a clean cask, recently sulphured. Acidity, when the cider is turning into vinegar, is corrected by pouring into the cask a small quantity of good olive oil, and, if necessary, a little neutral tartrate of potash or powdered lime or chalk is added. Bitterness is corrected by adding sugar and tannin. Greasy cider occurs when it becomes sticky and greasy, and flows like oil. It is remedied by adding tannin dissolved in water.

THE MINING INDUSTRIES OF CUBA.

The development of mining in Cuba may be said to date from 1830, when companies were formed for working the copper mines in the province of the Oriente. During the nineteen years following, there were exported more than 600,000 tons of copper, and this only from two mines, the Consolidada and San José. Subsequent to the paralysation caused by the first war of independence (1868), and as a result of the demand for minerals, the spirit of enterprise was stimulated, with the result that numerous copper and iron mines were discovered and worked in Oriente. Soon after, manganese mines were discovered in the same province, and naphtha, gold, and copper in Santa Clara. A revival of the industry took place immediately after peace was restored in 1899, a good deal of prospecting being done in the province of Pinar del Rio, where it appears that coal mines exist. It is also believed that asphalt and copper mines are to be found in that province, and in Habana and Matanzas. According to the American Consul at Cienfuegos, there is not sufficient knowledge of the real mineral resources of the island to make an accurate estimate. The mineral resources are represented by the following products:—Gold, silver, iron, copper, manganese, lead, asphalt, petroleum, naphtha, graphite, amianthus, asbestos, zinc, mercury and coal. These minerals are found in most of the provinces, but the richest district is the province of Oriente, followed in importance by Santa Clara, Camaguey, Pinar del Rio, Matanzas and Hobana. The total number of mines surveyed and the boundaries marked in the island up to December 31, 1905, was 386, containing 51,550 acres, divided among the provinces and classified as follows:—Asphalt, 78; copper, 77; iron, 63; pit coal, 11; oxide of red lead, 1; manganese, 84; gold, 13; graphite, 2; lead, 5; zinc, 2; asbestos, 1; other kinds, 49; making a total of 386. The total area of the mining districts of Cuba is 56,395 acres, of which 44,586 belong to the province of Oriente, 4,288 acres to Santa Clara, 5,202 to Camaguey, 1,361 to Pinar del Rio, 444 to Matanzas, and 514 to Hobana. Of the above number of mines, very few of iron, manganese, and copper, in the province of Oriente, are in operation. The others can be considered only in concessions waiting for funds for exploitation. The administration, according to the laws in force, cannot compel the miners to work their claims. The owner is in possession of his mine in perpetuity, and at his own will may work it or not. The only cause of forfeiture established by the law is the failure to pay the annual taxes. The applicants for mines can, according to law, ask for one, or several claims at the same time. A claim, or "pertenencia" as it is called, is 984 feet long by 656 feet wide, except when the mines are of iron, coal, anthracite, lignite, turf, asphalt, or bituminous clays, when the pertenencia is 1,640 feet long, and 984 feet wide. The taxes to be paid to the Government are twenty shillings yearly for every 2½ acres, when the mines are of precious stones or metalliferous substances. In the other cases the tax is eight shillings for every 2½ acres. The annual production of the mines actually worked is valued at £300,000.

HOME INDUSTRIES.

Mining in Cornwall.—Attention has been directed more than once in these notes to the probable effect of the great rise in the price of metals upon mining in Cornwall. It was reasonable to assume that tin mines shut down when tin was at a price that left only small profit to the richest mines would be re-opened now that tin is quoted at record rates, and that improved machinery and more modern methods of working would be introduced. But the Cornish miner looks aghast at innovation. He has no objection to the outside capital necessary to extend the workings, it is outside methods and management to which he objects. Engineering firms that have examined the existing plants with the object of inducing the adoption of more economical appliances for pumping, &c., have not met with much encouragement. And the explanation is not far to seek. As Mr. H. A. Le Feuvre points out in an interesting communication to the *Times*, quoted here, Cornish mining has largely remained a local industry, into which the eastern engineer, the manufacturer of mining industry plant, and tools, and the purveyor of stores, had little chance of entering. The only way to break the local monopoly was to obtain control of properties for the purpose of exploiting mines, and this has now been done to some extent, and will probably be done to a larger extent in the near future. The Cornish mining industry is being decentralised and recentralised in London, to the probable great benefit of the engineers, and the mining machinery manufacturers. Is it possible for Cornwall to regain the position as a tin producer she lost many years ago. At the beginning of the last century, Cornwall produced more tin than any other country in the world, to-day four other countries are larger producers. Is the loss of position due to the lack of mineral reserves? The popular impression is that the tin mines of Cornwall are now worked at such a depth that the cost makes profitable working difficult where it is not impossible, that the tin mining industry of Cornwall is now in the position the Transvaal gold mining industry is expected to be in fifty years hence. But this would seem to be a very erroneous view of the position. Only one mine in the country has yet reached the depth of 3,000 feet, and there it has a lode as productive as any in its history of a hundred and fifty years. Of the hundreds of abandoned mines, Mr. Le Feuvre puts the average depth at less than 800 feet, and apart from them there are vast tracks which have never yet known the prospector's pick. In Mr. Le Feuvre's opinion there is in the West of England a vast field for metalliferous enterprise, and this view is that of other competent examiners. Capitalists are coming round to this view, and it may be that before long invention and enterprise may restore Cornwall to its old position in the mining world.

Employers' Liability Insurance.—The Employers' Liability Insurance Companies Bill now before the House of Commons, and which has been introduced on behalf of the Board of Trade, supported by the Home Office, will, if it becomes law, have an important bearing upon employers' liability insurance business. Its principal clause extends the application of the Life Assurance Acts, 1870-72, which require a deposit of £20,000, and the submission to the Board of Trade of annual accounts and periodical valuation statements on prescribed forms, to "every company, whether established before or after the passing of this Act, which carries on within the United Kingdom the business of insuring employers against liability to pay compensation or damage to workmen in their employment, subject to such necessary modifications and adaptations as may be made therein by Orders in Council." Companies transacting employers' liability insurance business before the commencement of the proposed Act which shall prove to the satisfaction of the Board of Trade that the funds set apart and assured for the satisfaction of claims of employers amount to £40,000, and others which have already made a deposit under the Life Assurance Companies Acts, are exempted from the provisions of the proposed Act. It will not, therefore, affect large insurance companies which have been transacting workmen's compensation business. The Bill is aimed rather at small accident companies, which are springing up in considerable numbers, but which will be severely weeded out if they have to make a deposit of £20,000. It is very desirable that companies of this class, without the necessary capital to insure the fulfilment of obligations, shall disappear, but the Bill, if it passes, will still further concentrate insurance business into a comparatively few hands. This process of concentration has been going on for some time past, and it is by no means at an end—the proposed sale of the business of the Central Insurance Company to the Liverpool and London and Globe being the latest indication of it—and it is viewed with something like uneasiness by those who are anxious to avoid anything like a monopoly or "ring" in the insurance world. The public have to be protected against mushroom insurance companies, but wholesome competition is also necessary to prevent inequitable rates and conditions.

A Small Duty on Coal.—Many are likely to think that a good deal can be said in favour of Mr. James Syke's suggestion of a small duty per ton on all coal raised. On last year's output a penny per ton would yield over a million sterling. The money would be easily collected, and the tax being added all round to the cost of production, its incidence would be borne by every class in the country, with far more equity, as Mr. Sykes contends, than many other taxes existing or proposed. There would, of course, be a demand for rebate on exportation (which would reduce the yield by about one-fifth), and Mr. Sykes recognises that this would be "considered by some a highly objectionable reversal of the policy just abandoned." The Chancellor of the Exchequer is not likely to adopt the suggestion, but it invites discussion.

Wool Supplies and Prices.—The outlook for the wool grower continues very bright. Values of every quality of wool are considerably higher than at any time during recent years. The following figures are interesting:—

	70's	64's	60's	50's	40's
	d.	d.	d.	d.	d.
1899	25	24	23	15½	10
1902	21½	21	20½	11¾	8¼
1906	27½	26¾	26½	21½	16½
1907	29½	28½	27½	22½	17¾

The price of every quality of wool is higher, with one exception, and this notwithstanding exceptional supplies. Not for more than ten years has trade in Bradford been so busy as it is now. Consumption is believed to be upon a larger scale than ever, and high prices have forced a lot of trade on to cotton. Even in hosiery yarns, cotton and wool are now twisted with quite acquired ingenuity. And in the dress goods trade, says the Bradford correspondent of the *Economist*, fabrics are lighter in weight, and yarns of finer counts are required. Hence, although spinning machinery is engaged to its utmost capacity, the quantity of wool passing through is probably less. It is certainly very much less per spindle than it was a few years ago. There is little likelihood of values receding notwithstanding the large supplies.

Cotton.—The American crop results are very surprising. During the last month there has been an enormous volume of cotton pouring into sight. Whilst a falling off was expected with the advent of March, the contrary has been the case. The total crop brought to light to 8th March was 11,497,000 bales, as against 9,028,000 bales for the corresponding period of last year, and 9,992,000 for 1904-5. Messrs. Neill Brothers had estimated a total of 13,500,000 bales, and notwithstanding the latest figures they adhere to that estimate, although, if deliveries continue on the same level as in 1905, there will be a crop of something like 15,000,000 bales. The visible supply for the world on March 8th of American cotton only was 4,036,000 bales, as against 3,404,000 bales on the same date last year, and 2,989,000 bales in 1905, whilst all sorts amounted to 4,712,000 bales, as against 4,032,000 in 1906, and 3,458,000 in 1905. Great Britain has taken 1,844,000 as against 1,665,000 bales, the Continent 2,615,000 as against 2,107,000 bales, and Mexico, Japan, &c., 151,000 as against 82,000 bales, leaving 3,548,000 as against 3,260,000 bales for the United States and Canada. With more than five months yet to be accounted for, the cotton crop is two and a-half million bales above the parallel figures of last year, and one and a-half million bales ahead of the parallel figures of 1904-5. The quotation for middling American cotton has dropped to 6d. per lb., comparing with 5·77d. per lb. a year ago, and 4·31d. in 1905.

Canal Haulage.—The application of electrical power for haulage is making some headway on canals. The latest instance is on the new canal which connects the Havel and the Spree. This canal is about twenty-five miles long, and has cost over £2,000,000 to construct. It runs partly through a series of lakes, but on the other sections of the waterway a tow-path is laid on both banks, at an average level of five feet above that of the water. The method of haulage adopted on the canal (after a series of comparative tests) is described by Professor E. W. Marchant, writing in the *Times*, as one in which tractors, running on a light railway on the tow-path, haul the barges along, current being collected from an overhead wire by a bow collector, specially designed to give a large range of vertical movement, and returning by the rails, which are, of course, bonded. An interesting feature in connection with the Teltow installation is the complete centralisation of power that has been effected. Everything in connection with the canal is electrically operated. "The lock-gates at Kleine Machnow (which are of the portcullis type) are worked by inductive motors fed from the central station; the capstans at the locks, the special lock locomotives, and the cranes at the various landing stages along the canal brink, are all driven by motor power."

Shipbuilding at Preston.—Whilst shipbuilding elsewhere has been exceptionally active, it seems very likely to die out at Preston, if it may not be said to be already dead. Thirty years ago Mr. Allsupp opened a shipyard on the Ribble, which he conducted in a small way up to a year or two ago, when it was taken over by the Caledonian Shipbuilding Company, but it was found impossible to make the yard pay. Many of the men were discharged, and new orders were not sought. An attempt was made to sell the yard as a going concern, but a purchaser has not been found, and it is expected that it will soon be closed. The shallowness of the river makes it impossible to build large craft, and there was never any likelihood of Preston becoming the seat of an important shipbuilding industry. It is indeed a little surprising that the attempt was ever made to create such an industry there.

GENERAL NOTES.

Ecuador.—In his last year's report upon the trade of Ecuador, Mr. Consul Cartwright referred to the progress of the Guayaquil and Quito Railway Company, and in his report just issued (Cd. 2383) he says that the date at which the conclusion to Quito will be fulfilled is very doubtful. The project of a railway to Curaray (Amazon district) has been open to competition by tender, and the attention of the Government has been given to the cart road from Papallacta to Baeza. Imports from the United Kingdom remain larger than those of any other country, but the difference between them and the United States is very slight, Germany being third.

ABYSSINIAN COFFEE. — In his report upon the trade of Abyssinia (Cd. 3283), Mr. Vice-Consul Johnstone directs attention to Harrari coffee, which is cultivated with great care round the town from which it takes its name. It is known on the London market as "Long Berry Mocha." A large proportion of the harvest finds its way to Aden, where it is mixed with Yemen coffee for export. "Abyssinian" coffee comes from the south-west provinces of the country. The forests in which it flourishes are the property of the District Governments. The nobles and officials are allotted a share of the harvest according to their rank. The poorer inhabitants cultivate the plant, though they do not produce a difference appreciable from the berry of the wild shrub. The coffee is pronounced to be of good quality, but since it is shaken off the shrub and then picked off the ground, it loses a certain amount of its aroma in the process. The quantity passing through Adis Ababa every year is said to amount to from the value of 200,000 to 300,000 dollars. The export of Abyssinian coffee seems now, to a great extent, to have been diverted to the Nile, it being estimated that as much as two-thirds of the total amount leaves Abyssynia by that route.

TEA EXPORTS TO AMERICA. — The North American market is becoming a very important outlet for Indian and Ceylon teas. The rapid growth of this market is shown in the tables compiled by Messrs. Gow, Wilson and Stanton, and to be found in their weekly circular. In 1901, the Indian tea taken to North America amounted to 6,960,000 lbs., and with a trifling set-back in 1903, the import has continuously increased, the import for 1906 being no less than 17,653,851 lbs.; and with Ceylon tea, the increase has been almost as great. In 1900, Ceylon exported to North America 8,495,288 lbs., and with the exception of 1904 and 1905—in the latter year, the export fell to 18,998,373 lbs.—the growth has been continuous, the export for last year amounting to 22,769,875 lbs. In 1906, the North American market took practically a quarter of the whole quantity of Indian and Ceylon teas used outside the United Kingdom, viz., forty millions, against thirty-two millions in 1905. In 1900, the quantity taken, as stated above, was only fifteen million lbs. Not a little of this increase may be attributed to the steps taken in India and Ceylon to make their teas better known in America.

THE NEW HEBRIDES.—The recent discussions in Parliament and elsewhere upon the New Hebrides will cause the report of the Resident Deputy-Commissioner (Cd. 3289) just issued to be read with unusual interest. A good deal has been made in discussions upon the Anglo-French Convention of the fact that two-thirds of the present white population are French, as against one third English, but Captain Rason shows that this French numerical snperiority is only of very recent date, and is due to other than normal increase. At the end of 1900 the French settlers numbered 182 as against 167 British. During 1901 the French made every endeavour to increase their settlers, with the result that at the end of that year they numbered 293 as against the same number of British settlers as formerly. Then the Commonwealth tried to increase the number of British settlers, and brought the total up to 217, but the French in the meantime had increased to 401, and by the end of 1905 the numbers stood at 225 British and 417 French, the population to-day being practically the same. Captain Rason says that the French Government has been much more liberal in its treatment of French settlers than the British Government dealing with British settlers. These latter have suffered especially from the high duties in Australia upon maize. These duties were imposed almost immediately after the creation of the Dominion, and amount to 35 per cent., the result being that little or nothing is now left to support the British planter whilst his cocoanut trees or coffee is maturing. The freight upon maize to Sydney has been reduced from the prohibitive rate of £2 per ton to 7s. 6d. per ton, which makes it possible to send one crop of maize to Sydney a year. But the New Hebrides planter gets no profit from the price obtained. The average cost of shipping a sack of maize to Sydney, including all charges, is 6s. 6d.; the average market value of maize in Sydney is 10s. to 11s., leaving 3s. 6d. to 4s. 6d. gain to the grower—and it costs 4s. to grow a sack of maize.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MARCH 25...Farmers' Club, Whitehall Rooms, Hotel Metropole, S.W., 4 p.m. Mr. A. D. Hall, "Agricultural Education and the Farmer's Son."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Mr. W. Rickmer Rickmers, "Photographic Report of a Journey through the Highlands of Duab (Zarafshan, &c.)."

Actuaries, Staples-inn-hall, Holborn, 5 p.m.

Medical, 11, Chandos-street, W., 8½ p.m.

TUESDAY, MARCH 26...Asiatic, 22, Albemarle-street, W., 4 p.m., Mrs. W. R. Rickmers "Scenery, Cities, and People of Western Turkestan."

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Mr. Moses Kellow, "The Application of Hydro-Electric Power to Slate Mining." 2. Mr. A. H. Preece, "Electrically Driven Winding Gear and the Supply of Power to Mines."

WEDNESDAY, MARCH 27...Geological, Burlington-house, W., 8 p.m.

United Service Institution, Whitehall, S.W., 3 p.m. Col. H. B. Jeffreys, "The Native Races of South Africa from a Military Point of View."

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

CORRECTION.—Indian Railways, *Journal* p. 462, col. 2, ll. 20-21, should read "the average mileage per locomotive of all classes per annum is 27,124," and ll. 26-27 "the goods vehicles number 11,566, these having an average daily mileage of 63 miles."

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FRIDAY, MARCH 29, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

LIST OF MEMBERS RESIDING ABROAD.

Lists of members resident abroad have been prepared, and can be obtained by members on application to the Secretary.

The following lists have been printed:—

1. Members resident in India, Persia, China, Japan, the Malay Archipelago, &c.
2. Members resident in Africa.
3. Members resident in Australia, New Zealand, Tasmania, and Polynesia.
4. Members resident in the Dominion of Canada and Newfoundland.
5. Members resident in the United States of America.
6. Members resident in South and Central America, Mexico, and the West Indies.
7. Members resident on the Continent of Europe.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, March 14; LORD AMPTHILL, G.C.S.I., G.C.I.E., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said that Sir James Thomson was lately a Member of the Council of Madras. He thought he should not be considered impertinent in presuming that a proportion of the audience had not a clear idea of what the term "Member of Council, Madras," meant, and he would endeavour to explain it in a few words. That part of India which was designated as the Madras Presidency was a country larger in area than the British Islands, and contained a greater population than that of the United Kingdom and Ireland. That very large portion of His Majesty's dominions was governed, subject to the higher authority of the Government of India and the supreme control of the Imperial Government, by a triumvirate, officially known as the Governor in Council. The Governor, who was invariably appointed from the ranks of public men in this country, was assisted by two senior members of the Indian Civil Service, who were his colleagues and were known as Members of Council. It would be seen that the position of Member of Council was one of very great power and responsibility. The Council consisting of three, it would be realised at once that the Governor could be easily put in a minority, and that he could do nothing without the consent of at least one of his colleagues. That was the position to which the author attained after thirty years of service in India. Those present would understand that it was not by mere seniority that Sir James reached that position, and that he had for a time held an even higher office, namely, that of Governor of Madras. If anything had been seriously wrong with the Government of Madras, either during the period when Sir James was at the head of it, or during the longer period, when he was one of what might be called the Cabinet of the Madras Government, something would have been heard about it in this country. Recent experiences amply illustrated the truth, that the men who were responsible for the administration of different parts of the Indian Empire, and for the permanent conduct of affairs in the great departments of State in that country, only became known to the great British public when something went wrong. It might, therefore, be assumed that, as the author's name had not been prominently before the British public during the time of his service in India, he was, at any rate, not responsible for any serious mishap. His own feelings towards Sir James were a matter he could not intrude upon the audience. Those present would realise that when one had worked with a man in perfect harmony and unbroken friendship for a number of years at concerns of such great importance and interest, it was impossible to feel otherwise than grateful and affectionate towards him. Those were his feelings towards Sir James Thomson, whom he had much pleasure in calling upon to read his paper on the city of Madras, a part of the world which was dearer to them both than any other city they knew.

The paper read was—

THE CITY OF MADRAS.

By Sir James Thomson, K.C.S.I., LL.D.,
Late Member of Council, Madras.

A brief foreword is necessary by way of explanation and apology. I undertook this paper with considerable reluctance, for I have no special knowledge of the subject, but I felt that the city which welcomed me to India thirty-five years ago was in some disregard, and, since more competent spokesmen refrained, that I ought to do what I could for her appreciation. Madras has been my headquarters for only a part of the last eight years, and when there the work of the day left no leisure for inquiries of the present sort. Of current social and municipal life I was necessarily more or less aware; of the past beyond the main facts I confess myself only a student. And now, on this side of the world, I am unable to verify many points that suggest themselves, and I despair of setting before you in the brief time at our disposal any duly-proportioned account of what Madras has been and is on her two hundred and fifty years of existence.

I should first indicate the sources of information for the benefit of whoever wishes to be informed further. Mr. Talboys Wheeler, as a consequence of his appointment, in 1860, by the Madras Government to report on the character and value of the records in the Government-office, was enabled to produce in 1861 the papers afterwards collected and issued under the title, "Madras in the Olden Time," which exhibit the history of the Presidency from 1639 to 1748, and are a storehouse of information for that period to all who come after. The Madras records, however, were defective till 1670, and in 1902 Mr. Foster supplied the information regarding the "Founding of Fort St. George," which was available from the records of the India Office. Mrs. Penny's "Fort St. George," a vivacious and most readable if somewhat discursive volume, was issued in 1900; Mr. Leighton's "Vicissitudes" in 1902, so interesting in personal details and so clearly presented that it is to be regretted that he has not carried his work beyond 1798. Colonel Love, in describing the pictures in Government House and the Banqueting Hall in 1903, has at the same time with great care and accuracy set out the history of the Fort and other connected matters; and Mr. Penny in 1904 produced "The Church in Madras in the Seventeenth and Eighteenth Centuries" with minuteness, and correlated with general history in a very useful manner. Sir Charles Lawson's "Memories," published in 1905, give a deal of information regarding persons and families. Besides general histories, much may be learned from the lives of individual worthies and the notes and writings of visitors and sojourners. My chief difficulty has been to find any comprehensive survey of the nineteenth century: it is the earlier history that has had fascination for narrators; the quietude and even tenour of later days attract no chronicler with an eye to effect, and are no doubt dry-as-dust to all but a few.

Between the beginning of the century and 1639, the East India Company had established trading depots or factories at Bantam in Java, at Surat on the West Coast, and at Masulipatam, Nizampatam, and Armeghon, on the Coromandel Coast of India, and were maintaining an unequal rivalry with the Dutch, who were firmly seated at Pulicat, possessed of greater resources, and with a firmer hold and greater experience of the markets in the exchange of precious metals and broadcloth for the silks, chintzes, precious stones, and spices, which were coveted in the West. The Portuguese at San Thomé were in decadence. The native authorities in that part of the country which contained Pulicat and San Thomé, relicts of the Empire of Vizianagar, whose headquarters were at Chendragiri, had evidently a sense of the value of competition in trade, and invited the settlement of the English. They accordingly moved from Masulipatam to Armeghon in 1626. There they found themselves no better off than at Masulipatam, and returned thither six years later, but kept up Armeghon on a reduced scale. It was an impossible and naturally "unprofitable" place for the company's purposes, as any one who has seen it even at the present day would understand, and the directors, in 1638 or 1639, ordered its abandonment. The Nayak—the local officer under Chendragiri—renewing his advances towards friendly relations, Mr. Francis Day, then chief, set out in 1639 to negociate, and was so taken with the quality and prices of the cloth specimens shown him at Madraspatam compared with those of Armeghon, that he became instant for settlement, and obtained a *firman* or grant from the Nayak. The copy thereof recites that Day had, on solicitation, repaired to "our port of Madraspatam" and held conferences, and the Nayak, out of special love and favour for the English, had granted to him or those in

his place power to direct and order the building of a fort or castle in or about Madraspatam, and full power and authority to govern and dispose of the government of Madraspatam for two years after it was fully occupied, and thereafter to receive half the custom and revenues of the port. The Company were to be duty-free on their imports and exports there for all time, and to pay only half duty on goods transported up into or through the Nayak's country, to have a perpetual free grant of minting and the Nayak as surety for their trading advances to approved persons, to be exempt from duty in respect of provisions bought in the Nayak's country for their fort and ships, and to have restitution of all shipping of the port that suffered wreck.

The factors at Masulipatam had full comprehension of the benefits conveyed, but the sanction of Bantam was necessary, expenditure was involved, and money was not a ready commodity then. They reported accordingly, and also to the Company, setting out the advantages of the place, the second of which was "the whole benefit of a town near by for two years, which town may be, at present, worth about 2,000 pagodas per annum." One seeks vainly for that town, and must conclude that Day was a very sanguine person even in the conditional mood. He was sent with borrowed funds to accomplish the removal from Armeghon to Madraspatam. The headship of local affairs was, meantime, transferred from Bantam to Surat, and the authorities of Surat, in December, gave a half-hearted acceptance to the project. Andrew Cogan had become chief at Masulipatam, and along with Day set to build the fort in 1640, but the money difficulty continued and the necessity of a fort had to be impressed on the Company in this wise: "It hath been a continued tenet among as many of your servants as have been employed in these parts that goods, especially paintings (*i.e.*, prints, chintzes), cannot be procured nor secured when acquired unless you have some place of your own to protect the workmen from the frequent enforcements of those tyrannous governors, and to lodge your goods free of the mischievous attempts which those treacherous Gentues or inhabitants of that country are too often ready to adfer against them;" and accordingly, and for their own reputation, the erection of the fort should proceed as it was now in good forwardness, and 300 or 400 families of weavers, painters, and other artificers had come to live under their protection.

Cogan made Madras the chief factory, and he and his colleagues had to argue with the Company taking the line that a highly profitable time was in prospect, and they had to choose whether they would or would not preserve or make "this trade of Karnatt;" and, dealing with a suggestion that had apparently been made that they might have put up at San Thomé as San Thomé had desired, declared that if it had been so, "you must have sought out for such persons as were both stick-free and shot-free, and such as could disgest poison, for this is their daily practice at San Thomé and no justice."

Cogan went home through Bantam, and with the support of the council there, but had to stand an enquiry by the Company on the building of the fort and on other matters. Concerning the first it was held to be "a very indiscreet action when the Company's stock was so small, but if ever the Company have a plentiful stock it may be very commodious and advantageous for them." By September, 1644, the fort had cost £2,290, and would cost £2,000 more for its proper completion. Fifty men were its complement of soldiers costing £54 6s. 6d. per month and fifty more would be required, and then "we need not fear any inland enemy near unto us in these parts."

This in rough outline is how Fort St. George came to be built; it is said to have taken fourteen years for completion.

The Viziangar Prince had meanwhile confirmed the Nayak's grant, when or how, does not appear. The Dutch in 1644 were threatening to become all powerful, and the English feared the same low state for themselves as menaced the Portuguese and the Danes, but things took a turn; Sree Rangaroyalu, the last ruler of his house, welcomed the assistance of the English against the Dutch, accepted a visit from Mr. Greenhill and four other Englishmen, and in November, 1645, issued to "the Chief Captain of the English and the Company of that nation," much the same sort of grant as they already held. But he calls the fort Srirangarayapatam "my town," "the town which bears my name," "one of my new towns," and he freely gives to the Company the town called Madraspatam and all the ground belonging to it, and "all the government and justice of the said town shall be executed by you." By 1647, the King of Golconda's general, otherwise the Nawab, had pretty well made an end of the Vizianagar Kingdom, was in amity with the Madras authorities, and had confirmed all the English

privileges. And a famine in the place had killed 4,000 in five months, and left the settlement with one-third the former number of weavers, painters and washers, and with only three factors and thirty-three soldiers. More famines were ahead; the English did not beget them.

To this day people wonder at Day's selection. In the early part of next century Alexander Hamilton came there with much experience of Eastern seas. He considered it a most incommodious place, the surf greater than elsewhere on the coast, its foundation sand, no drinking water within a mile, the sun from April to September scorching hot, and the place habitable only by the sea breezes; the soil barren, the trade not satisfactory since the place produced very little of its own growth or manufacture and had to feed itself from elsewhere, being indeed an emporium like Holland. He had a biting pen, and had no great reason to love the Madras authorities; still he has to record that the place was populous and rich, because peaceful Indian traders were there not worried by "encumberers of trade"; and it was near the Golconda diamond mines, and good bargains were to be made. In 1639 one can picture the site of the fort as a spit of sand between the sea and the north branch of the Cooum river, with Madraspatam probably a small fishing village to north of it. The sand ridge would continue northward up the coast; on the landward side, back of the ridge, was a depression, in part a swamp running along what is to-day Popham's Broadway and ending in the Cooum; and beyond that the plain with its small native villages to be afterwards mentioned, at its highest not more than 24 feet above mean sea-level, but for the most part as low as from 2 to 6 feet. South-west lay the island, then much more of a marsh than it is now in heavy rain: it was regarded as a possible salt factory. Directly south of the river the country was open, known later by the name of the Choultry plain, with Mylapore and San Thomé on the sea face of it. There is some proof that Day did not settle without looking further down the coast, and his reasons—the goods he was in search of, an open roadstead, and a friendly native authority—are all on the surface, and were then sufficient for him as they would have been to any one with as small choice.

The name *Madraspatam* already existed; its etymology has been an enigma since. *Madrasa*, meaning a college, may be ruled out at once; *Madarasen*, the Christian fisherman, is equally impossible; *Mandarajya*, the country of the stupid, is good for a jibe but not otherwise. Mr. Leighton adheres to *Madeiras*—timber—though there is nothing to show any great probability of or propriety in such naming. *Madre de Dios* has been suggested. *Madirass*, "the Indian town with flat houses," is shown on the north of the fort in the print in Fryer's new account, dating back to 1673. In my early service I remember a European veteran making the word so distinctly of three syllables that I had difficulty in recognising it. The probability is that there was some connection between the place and Portuguese San Thomé, three miles off, which helped it to its name, or possibly the Dutch, 22 miles to the north, at Pulicat, had christened it. The similarity to Saderas, Sadras, Sadraspatam, is curious, but Dutch Sadras dates back only to 1647. The native name, *Chennapattanam*, after Chennappa, father of the Nayak, has lasted till now and will last.

Coming to the fort itself, the first full account we have of it is in Fryer's book. It is there depicted as an oblong quadrilateral, walled on the north, east, and south, open on the west to the river, save for the garden and house walls, moated also on the south, and protected at each of the four corners, at the water-gate on the east and the two gates on the north, by 10 or 12 guns. Palisades connect the corners with the sea on the sea face. Inside this outer fort is the original fort, 108 by 100 yards, similarly protected at each corner by ten guns, with culverin along the battlements, and the governor's house set down diagonally in the middle. Two hundred men, he says, are mounted for duty daily, and there are 700 English and Portuguese in the Company's pay. I may as well observe that the doctor's figures are not always accurate, but that at this time Madras had good reason to have a small army. He has a good word for the houses and streets. The inner fort stood more or less on the site of the present secretariat. The English folk—Company's servants and freemen—occupied the south and west, the Portuguese the north of the outer fort, with a chapel named St. Andrew's for their use: you may note it in Fryer's print; elsewhere I find the date 1675 assigned to it. The whole enclosure went by the name of the White Town. Outside, to the north, divided by a wide parade used as a market place, was the heathen town Maderas, of "divers long streets, chequered by as many transverse." This was the Black Town of those days occupying what is now the

north glacis and beyond, peopled by the natives attracted by the Company's trading.

In 1670, Governor Langhorne obtained from the Nawab of Golconda a re-grant of the fort and town for a payment of 1,200 pagodas per annum, free of any further liability, and this was confirmed by the succeeding Nawab in 1672. By 1677, the forthouse and outer fort walls required restoration; St. Mary's, the fort church, was built at the expense of the residents in 1678-80, the first church of the English nation in India, and retaining to this day most of its original construction; in 1688, the White Town was 400 yards long by 100 yards broad, and had 12 streets with 129 dwelling - houses and godowns, yielding a yearly rent of 124 pagodas 9 fanams. A directory exists for that period, showing owner, occupier, and rent due, and there were 11 christenings, 13 marriages, and 101 burials in the year. Job Charnock came there with his people in 1689, and left the next year to found the capital by the Hugli. In 1692, by petition made to the Vizier of the Mogul, then at Gingee, that the Mogul himself should grant a *firman*, that the rent of 1,200 pagodas for Madras and Triplicane should be taken off, that Tandore (Tondiarpett), Purasapakam, and Egmore, three small towns near by and worth 300 pagodas per annum, should be given rent-free, and that they might coin rupees with the King's stamp, grant, it is said, was made accordingly, but I cannot find that the rent ceased to be paid. The grant cost 1,500 rupees, as present to the Nawab Zulfikár Khan. In 1708, on a present of 200 pagodas, the Nawab granted Trivatore, Kattiwak (Ennore), Nungambakam and Viyasarpadi; it cost 200 pagodas more to stop the clamour of the officials at San Thomé, who held that the towns valued at 1,500 pagodas were worth 3,000, and even the *firman* of Farokhsir did not put the Company in possession without much trouble. The tale of acquisition may as well be completed at this point. Vepery, Perambore, and Pudupakam were obtained in 1742, on the accession of the young Nawab Saadutullah Khan, and Mylapore and San Thomé in 1749 from the Nawab Mahomed Ali in gratitude for English assistance. Trivetore and Ennore are outside; the others make up the present municipal area.

The local revenues of the Company about 1732 were from farms of betel and tobacco, spirit licences, measuring duty on grain, rents of the out-villages, quit rents of the town proper, scavengers' duty and minor items, but mainly from sea and land customs, yielding a total of over 70,000 pagodas—about £28,000—and the local charges ran to about half this sum.

Recurring to the White and Black Towns: in 1689 in fear of a Mogul force Black Town was ordered to be entrenched and walled with turf and clay, and by 1692 a brick wall took its place, in respect of which ex-Governor Yale next year was invited to pay up 3,483 pagodas and refused to do so. This wall had defences, "points" they were called, similar to those of White Town. Lockyer found it so in 1703, and White Town much as already described. A new fort house was built sometime in the early years of the century, and the inner fort walls replaced by the fort square in 1715. By 1733 the White Town is 620 yards long on the surface, 320 yards on the north and 180 on the south face, the river continuing to limit it on the west as before at more or less the north-south central line of the present fort. Commodore Barnet in command of the British squadron in the war that broke out in 1744, who died at Fort St. David in 1746, wrote of it scathingly, "works rather built by chance than by design . . . . bastions placed contrary to all rule; the curtain no better than a long unflanked garden wall." Peyton and the fleet having vanished and left the seaway open, the fort stood only a three days' bombardment by La Bourdonnais, and surrendered at discretion.

Before that time Black Town was stretching out arms northward—Muttialpett, east of what is now Popham's Broadway, and Peddanaikpett, beyond the channel that came down the Broadway. These pettahs had "out choultries," or batteries for defence, in a line westward from the present north groyne of the harbour to the north river, and adown it to the Cooum, but when serious trouble arose the smallness of the military force of the Company, and the necessity of concentration on the fort itself, made them useless for their primary purpose.

Let us now endeavour to realise in some measure the life and work of the settlement not embodied in wall and battlement or in adding village to village during these hundred years. There were twenty-one agents, presidents, or governors, from Aaron Baker to Nicholas Morse; many notable, several masterful, not all honourable, perhaps, as we count honour at the present day, but, to judge by the records, zealous to act the part of "a good husband for the Company, never giving a present but when absolutely necessary and

with a prospect of getting some privilege for it." Giving, however, begat giving, and too often the privilege obtained was to be let alone. Another note could be sounded as in 1687, when the Council is instructed, probably by Josiah Child, Chairman of the Court of Directors, that the King of Golconda is to be told that "We are none of his subjects and claim the sovereignty of the small territory belonging to Madras paying unto him our agreed tribute of 1,200 pagodas per annum. And if he break with you upon these terms we require you to defend yourselves by arms, and from that time renounce paying him any more tribute." These were brave words if the writer had been in Madras instead of in Leadenhall-street.

The Company was not easy to serve, in the early days at least; it was an offence to them that their servants who could not possibly live on their salaries should make money in private trade; they were only too ready to give ear to accusations and back-biting and to strike without hearing. Their wrath against interlopers was justifiable and understandable enough; such were pirates or poachers in the Company's preserves. They were pious in their despatches, zealous to promote religion according to the tenets of the Church of England, and tolerant in a measure of Romish practices and priests for those of that faith provided that they did not proselytise. The local officers were tolerant in greater measure—of necessity—but in religious supply they admitted no authority, Padroado, patriarch, or other, to claim rights of appointment to minister to the Catholic community within their bounds.

And it is difficult for us to comprehend how a scrupulous servant, governor or other, could discriminate between his own and the Company's trading interests. Possibly there was an idea that whatever was not occupied by the Company's funds or orders was the natural right of any servant that had money for employment, and that the company suffered no injury thereby. When Governor Yale fell out with his Council he swore he had not used the Company's cash to his own profit but had often freely supplied their occasions, and for two years past had nearly 100,000 pagodas of his friends' consignments lying dead for want of an opportunity to invest it, besides some of his own. On the Council's insinuation that his estate might on inquiry be found "too mean" he was hurt, and became ironical: "I think you are a little unreasonable; that my 20 years' diligent service in India and trading above 500,000 pagodas should be too poor a crop for you is hard, but I cannot help it, having used all honest endeavours to do better, so pray be contented."

Wheeler notes of Governor Higginson (1692-98) that he seems to have been the first Governor of Madras on record that retired from the Residency without a stain on his name. We should not grudge one white crow to a rookery—if it is at all proper to so describe honourable gentlemen—but he had a warm patron in Child, and I have not found the record of his acquisitions.

Pitt's "great concerne," and the trouble it was to him, are graphically set forth by Sir Charles Lawson; the spirit of the interloper had dwelt too long with Pitt for eradication, and he could not have denied himself the luxury of a good private bargain. When the Company did grant liberty to their servants to trade in the East and to send home goods under declaration, cloths, pepper, and precious stones were specifically *tabu*.

The Fort was a working and living residence with the Governor as head of the business, responsible with his council to their honourable masters for maintaining and extending trade, showing profits, and keeping the establishment in order to these ends. Apprentices, writers, factors, junior and senior merchants, councillors, surgeon, chaplain, and schoolmaster, lived under the President's eye, and were in commensality till 1722. Table expenses had then become excessive and a fixed sum had to be prescribed. The councillors divided oversight duties among them as book-keeper, warehouse-keeper, customer and justice, mint master, paymaster; elaborate rules, business, moral, and disciplinary, for the conduct of all from councillor to garrison soldier, were promulgated in Langhorne's and Master's times, with penalties of purse and person that, especially for the soldiery, were not trivial. The ultimate cure for the obdurate was to be sent home. Drink and the absence of healthy recreation clearly had much to answer for in misconduct.

The settlement of those that were useful for manufacture and trade in the Black Town and in the Pettahs was encouraged. Triplicane was a weaving and painting suburb in the early days. Governor Collett, in 1719, fostered the establishment of a hamlet called after him near to Trivetore; Chintadripett was built on advances in 1734, also for the promotion of the weaving trade. Contracts had to be arranged

with the native suppliers, dubashes, or workmen; books and accounts kept; bleaching, dyeing, painting, weighing and valuing of precious stones and metals, examining, passing, and packing for shipment seen to; the English stocks of broadcloth, iron, lead, tin, copper, weapons of offence, the lustres and mirrors the remains of which are so prominent in native furnishing till this day, all to be set out and sold. Article 9 of the Company's charter of 1693 bound them to export annually English goods to the value of £100,000 at least. The principal exports to Europe were cotton goods of course, with pepper, cardamoms, rice, sandal-wood and precious stones, and tea, china, spices, and other things obtained from the Far East. The Company's trade was small compared with that of its servants, the free merchants or licensed traders, Armenians, Jews, and others. The first market place I said was between the Black and the White Towns; later the sea gate was the mart; Hamilton found the council chamber or the governor's apartment in use; at the end of the century the Exchange was built. The native workmen would strike occasionally and withdraw and have to be cajoled, paid, or coerced to return; attempts to tax them for municipal improvements were always resented; and the quarrels of the right and left hand castes—the Telugu Comattis and the Tamil Chetties—were a feature of the native town life for long requiring the Council's interposition. On this side of the world calicoes and fine muslins were in great demand, and the home clothing industry invaded. In 1719 the Spitalfields weavers broke out and apparently behaved much as the Swadeshi rank and file in Eastern Bengal have done or are reported to have done in recent times. In 1727 the Council got alarmed at the diminished trade and apprehended utter ruin, ascribing this to the French, Armenians, and Moors (Mussulmans) using shipping not of the port and importing elsewhere, to English supercargoes taking up Madras money for trading and dallying in Bengal impeding "quick circulation," and to unlicensed persons trading; and took steps accordingly. The Council might fittingly regulate their own servants, reason with Armenians living under their protection, and deport interlopers; but when, as in Governor Macrae's time they took to fixing the price of grain under the market rate, forcing sales, and forbidding the export of silver and gold, circumstances as well as the Company were not long in showing the absurdity of their action. The Dubashes, or confidential servants of governors and others, had a faculty of bringing disgrace to their masters, which says little for the control their masters exercised; the popular suspicion—perhaps envy—of the class has had a long life.

In dealing with the native authorities the Council's policy was peace and conciliation, involving fair words and presents till one wonders how their exchequer stood the drain thereof. Child, as has been shown, was ready to fight, and when Daud Khan in 1701 refused their presents as insufficient, and began to blockade Madras, the determination of the later Pitts showed itself in their ancestor, and "considering that if there be not an end put to those unreasonable demands of Nabobs, the ill consequences will in a little time be no less than a vast annual charge to this place, and we all concluding this to be a proper time to withstand them," he beat the martial drum accordingly. Daud Khan's fondness for strong waters did no small service to the Company's affairs at this juncture. The next year he was more truculent, and it cost the Council 20,000 rupees to get rid of him. A more amusing episode was when John Pitt, cousin of Governor Pitt, being sent out under the charter granted to the new company, with the title of Consul, anchored in Madras Roads in 1699, on his way to Masulipatam, and intimated his arrival to "the President of the Company, yet by permission on the coast of Coromandel," and that he would salute if he were saluted. The Governor found the communication as well as the superscription "very odd," suggested that his cousin should read the Act of Parliament whereunder the old Company existed till 1701; didn't know if the *soi-disant* consul was a consul or not, but instructed him that it fell to him to salute the flag ashore and according to custom and good manners that would have been acknowledged; which made John Pitt so angry that he forgot his manners altogether and promised revenge for the "scurrilous letter" from Masulipatam. The old and the new companies amalgamated in 1701 and got their charter in 1702, and a son of Consul Pitt ruled in Madras from 1730 to 1735. One item of the new charter in which probably Streynsham Master's hand is traceable, is a contemplation of license to the Company's servants to trade in the Company's ships.

Reverting now to the capture of Madras in 1746, Dupleix and La Bourdonnais disagreed

for weeks over the treatment the place should receive, the former desirous to sweep the English from the country, the latter ready to hold the place to ransom; meanwhile the plunder of the city was making its way to Pondicherry. A cyclone sent La Bourdonnais packing; the Nawab's son and Dupleix fell to fighting to the confusion of the former, and Governor Morse and others were marched off to Pondicherry. Robert Clive, writer, took French leave, and reported himself at Fort St. David, which became the British headquarters. The French held Fort St. George till the peace of Aix-la-Chapelle had effect in 1749; they cleared away the Black Town, and made a glacis north and south of the fort. In 1743 Major Knipe had reported to the Council on suggested improvements, and had accepted the proposal to turn the river away from and enlarge the fort on the west side which had always been insufficiently protected. Government was reseated at Madras in 1752, but from 1750 Knipe's plans had attention from the engineer-general, Benjamin Robins, and when Robins died his designs were carried out. Work began in 1755 and continued for three years with 4,000 labourers constantly employed, Governor Pigot actively superintending. The result was the fort somewhat as we now have it in shape. The extension doubled the internal area. The work done was only in time, for in 1758 the place was invested by Lally, Stringer Lawrence retreating into it before him. Lally shot and shelled it from the north and west and endeavoured to sap it for two months; the strenuous and gallant defence and his army's exhaustion compelled him to raise the siege. Simultaneously the English fleet under Pocock appeared in the roads, but the conflict was already ended.

Much naturally had to be done for renovation, and the Court decided to make it an up-to-date fortress. Work went on from 1760 till 1780. The curious will learn what was done from Colonel Love's book. The interior is 620 yards north to south and 330 east to west; and the enclosure is 42 acres; the total to the foot of the glacis 102 acres; the full armament was 534 guns. Its present armament and the disposition thereof are not to be talked of: there are more modern defences now in the shape of three batteries along the sea shore. The buildings within the extension date, of course, from that time; new barracks have been built by the St. George's Gate; the north wall and gates, the church and some of the houses south of it are the oldest buildings now. Clive was put up in the latter quarter on his arrival in 1744.

According to Mr. Twining, in 1793 the European merchants' counting-houses, stores and warehouses were still in the fort; so also were the best shops. Cornwallis entered it by the sea gate in 1792, and Colonel Arthur Wellesley is said to have occupied a house opposite the San Thomé gate in 1798. The fort house enclosed by the fort square continued to be the Governor's official residence even after the present Triplicane garden house was acquired. The present Accountant-General's office in Charles-street—the old Admiralty House—was also occasionally used by the Governor for public purposes.

The fort house underwent large repairs in 1819; wings were added to it, the fort square cleared away, the old banqueting hall between it and the sea gate, with its pillars that performed a journey to Pondicherry after 1746, did duty there and returned after the day of vengeance in 1761, became a clerks' office and eventually the record room. The fort house is now the Government Secretariat tenanted by secretaries and clerks who sigh for roomier accommodation; the headquarters of the Madras Military District are in Hanover-square. Changes in military administration are rapid at the present day, but I believe the Sepoys from Perambore still mount guard at the gates, and the European force is the wing of a regiment and a company of garrison artillery. The gun proclaims noonday to the town and shipping, the Executive Council meets once a week, and the Legislative Council, when summoned, in the Council chamber on the top floor overlooking the sea and St. Mary's. Commerce is fled to Black Town many a day since. But I do not think the fort sits sorrowful, though it may please the pride of youth to call it "an anachronism," "a withered beldame," or any the like scornful name, and to forget to honour father and mother to British India on the east, and on the west also if you admit that Clive's destruction of the pirates at Gheriah lifted Bombay from its low estate, for Madras may assuredly claim Clive as among the greatest of her makers.

> "Clive kissed me on the mouth and eyes and brow,
> Wonderful kisses, so that I became
> Crowned above queens."

May I vary the continuation to a placid mother now playing her children's games?

While the fort was receiving attention it was also considered proper to protect the Black

Town of the newer day—the old pettahs—along the lines of the old out choultries and the bound hedge, conjoining them by a strong wall. It was guarded by flanking works at intervals, and the ground outside cleared for a width of 600 yards. The length of the wall was about 6,000 yards. The notorious Paul Benfield had a deal to do with the expenditure for general defence; 20,000,000 pagodas — 8,000,000 pounds sterling—are said to have passed through his hands in five years. The wall continued as a whole till 1859; some of it still exists; part of the western esplanade became the People's Park, and the northern served the Madras Railway Company's original line into Royapuram.

In the middle of the eighteenth century the English and the French began to play for chief place in India with native princes for pawns; Stringer Lawrence, and Clive his pupil, had occupation, and the Madras Sepoys and the European regiment, which developed into the Madras Fusiliers, came into existence. Governor Pigot, in 1756, sent Clive, then Deputy-Governor of Fort St. David, along with Eyre Coote to Calcutta to avenge the capture of that place and the Black Hole outrage. That ended in the victory of Plassey, duly commemorated by Clive's son on the southern pediment of the banqueting hall in Triplicane. Active hostilities with the French were resumed in 1757; the defence of Madras in 1758 stemmed the tide which had overturned Cuddalore and Fort St. David. The French were vanquished in all quarters, and finally Coote captured Pondicherry and razed it to the ground. Mohamed Ali, Nawab of the Carnatic and our particular bantling, looked to rule by our assistance; the Company required money to pay the heavy war expenses and to prosecute their trade; the Nawab was ready to pay if only his subjects would pay him.

Unfortunately war does not immediately produce the fruits of the earth but destroys them, and exaction was no easy matter. Tanjore was a valuable principality affecting independence; its Raja was squeezed, and Pigot in 1763 prevailed on the Nawab to cede the Chingleput Jaghire or district. The treaty of Paris in that year restored the *status quo* with the French, and recognised the Nawab as independent and an ally of England. The Nawab without ready cash promised what he could not pay and fulfilled his wants by borrowing. Too many were ready to lend. By 1767 his debts were 88 lacs of rupees; this was consolidated into a 10 per cent. loan with—if you please—three Members of Council for trustees, and fifteen districts assigned as security for repayment. Commissioners were sent out in 1769 and 1771 to support the Nawab's independence under the treaty. Their presence was not a pleasure to the Company's servants, especially when the envoys agreed with the Nawab in preferring alliance with the Mahrattas to alliance with Hyder Ali, both of whom were now giving trouble. Hyder had dictated peace to the English at St. Thomas's Mount in 1769, a main article of which was a mutual alliance in defensive wars. The English failed him presently in assistance against the Mahrattas and he never forgave them.

In that same year Warren Hastings appeared in Madras as second in council, charged with the suppression of malpractices over the Company's piece goods and proud of his success in that regard when he departed in 1772.

The Company's trade was dwindling away. The country trade could not live under warfare, the China trade passed largely to Calcutta and Bombay. But the Company's servants in Madras throve—what with contracts for public works, army and naval supplies, and leases or farms in the districts that came under administration. In the sixties, seventies, and early eighties Mr. Leighton says Tammany ruled Madras. Trouble arose with Tanjore, which ended in its being reduced in 1773 and its revenues becoming available for the Nawab or rather for his creditors. The directors, however, by a majority determined to restore it and put an end to the misconduct of their servants. Lord Pigot, as he had then become, was sent out, but was kidnapped by members of his council interested to retain Tanjore, and died in restraint. The directors then sent out Sir Thomas Rumbold, who did well unto himself if to no one else, if he is truly credited with making £600,000 in the two years he was in power. Directly after he went Hyder burst upon the Carnatic. Baillie's disaster cowed General Hector Munro and all, and Warren Hastings sent Coote to succour them. Five regiments of Bengal Sepoys marched down the coast and through Madras to the Mount, and the second battle of Pollilore, and that at Porto Novo recovered British prestige. Lord Macartney took over charge of the Government in 1781, and the country had need of such a man. He was offered £30,000 as a present by the Nawab on his first visit, and to

the Nawab's astonishment, declined it. His troubles were over the Treasury's emptiness, the insubordination of the military officers, and the lack of men of high character and good attainments in the company's service. On retiring he declared his savings with reference to Pitt's act or for his own reputation as £30,000. Hyder died in 1782 and Coote died in Madras directly after he had come there in 1783 in expectation of Tippu's troublesomeness. In Sir Archibald Campbell's time, 1786-89, the Board of Revenue was started to deal with the land assignments made by the Nawab to pay the military forces and his creditors; also the Madras Post-office; and to the Governor and Lady Campbell were due the military orphans' asylums affording great succour to a large class sadly in need of it. Dr. Andrew Bell was an efficient superintendent for some years. Ootacamund has now received both sexes; and the civil orphans, poor whites and Eurasians, whose case was taken in hand 100 years ago, are now lodged in the buildings the military orphans occupied in Poonamallee road. When General Medows was Governor, Cornwallis thought it well to come and take charge of the operations against Tippu. Peace was arrived at in 1792, much to Tippu's impairment and to the delight of Madras which commissioned the Governor-General's picture and statue; the former is now in the Banqueting-hall, the latter—by Banks—was set up in the fort square about 1800, moved to the front of the Government office in 1825, and from there, on account of the havoc the sea air was causing to the marble, has just been transferred to the Connemara Library. It may be added here that Cornwallis re-visited Madras on his way to his second charge in 1805, and was presented with an address; and on his death the Cenotaph at Teynampett was instituted. The Madras folk could recognise and appreciate public devotion and righteousness whether they practised these virtues or not. The French Republic having declared war in 1793 the French possessions were again captured, and in Lord Hobart's time expeditions were sent from Fort St. George and took the Dutch territories—the Dutch having had to stand in with France—in Ceylon, Malacca, and the Spice Islands, so greedily longed for 200 years earlier. Tippu saw his opportunity while Bonaparte was pursuing his career of conquest in Europe and giving England enough to attend to in that quarter. Colonel Wellesley came from Penang in 1798, made himself acquainted by travel with the interior, and thereby no doubt was the better able to assist Lord Mornington when he, spurning the local deprecation of war, descended on Madras for the last fight with the Sultan. Lord Clive's five years' term was one of conquest and large territorial extension, and of the establishment of courts of justice. The Governor-General, besides settling the partition treaty, arranged the affairs of Tanjore and of the Carnatic, virtually annexing these territories. The portrait of him in the Banqueting Hall obtained by public subscription represents him seated in the verandah of the fort house, St. Mary's Church on his left, and the Union flying over the Sultan's standard.

Mr. Leighton gives an interesting description of the manners and customs of the Europeans of Madras at the end of the century. There was abundant hospitality, much and excellent drink, especially Madeira, even pale ale and porter; and the gentlemen drank heavily; the hookah after dinner was in sonorous evidence; Trichinopoly and other cheroots are of a later time. Deschamps had not then arisen, furniture and carriages were imported. Household goods and millinery were brought out by the East Indiamen; then, as now, the ladies would import for themselves from Paris and London; headgear and hooped petticoats were things to marvel at. A young lady, newly arrived, had to stay at home with an attendant squire till all had called, instead of as now setting off with her chaperone to drive over Madras to be introduced; and it must have been a trial to find herself restricted to one partner at a dance and to receive his call next day, unless, indeed, he were to be particularly desired or eligible. The chaperones played cards and took snuff Society was musical, or had the instruments for being so. With the men, duelling, gambling for high stakes, and wagering were common, Fashions in dress, manners, and morals took colour no doubt from this side of the world. The Pantheon, now swallowed up in the Central Museum, was a place for balls, banquets, and theatricals; later on the old college was used for the latter. At the Pantheon Sir Arthur Wellesley was entertained in 1805 on his way home after Assaye, when India had no more to offer his ambition, and opened the ball with Lady William Bentinck. He was invited to sit for his portrait, which was obtained in 1808. But Madras had small reputation for piety as concerned those who

had most to be thankful for, religion dwelling with the missionaries and the Vepery people. James Cordiner who succeeded Andrew Bell at the asylums at the end of the century found the civil servants superciliously arrogant, looking down on the military "to which they owed their pomp and splendour"; the private merchants more modest but independent; the lawyers pleasant and amassing money; all classes of Europeans living sumptuously and many spending £2,000 to £10,000 annually in maintaining their households. The men of a hundred years later might well sigh for such possibilities of saving.

The Houses of Agency, the collapse of one of which, or a lineal descendant thereof, has just brought so much heartrending sorrow on the thrifty of the whole Presidency, came into being through Pitt's Act restricting the earnings of the Company's servants, setting them to work with their creatures as *benamidars* to circumvent the law. Advances to the Nawab on mortgages of the revenues of the districts and controlling through their own managers, forestalling crops and forcing up prices continued the old game of hasting to be rich by grinding the faces of the poor, the while spinning inventions in this country with heavy import duties ruined the Indian production of cloths. When in 1803 a Commission sat for the final settlement of the creditors of the Nawab, it allowed £2,686,148 out of claims for £30,404,519, and declared that the investigation had deprived no one of any just right, while as to some of the cases reported it had defeated the most iniquitous combinations of fraud which were ever submitted to a legal tribunal. Under Cornwallis's arrangements for the service, the former evil things had room to pass away. They were not special in India to Madras, they are not special to any time; where there is no sufficient restraint of the law, of religion, and of morality, power will be abused by the unworthy and the public exploited.

The tale of the nineteeth century, if there were time to rehearse it, would be one of orderly and gradual improvement under settled and civilised Government. The Madras Government Bank was established in 1806, and lodged under the Exchange in the fort; the Bank of Madras that now is opened in 1843. The new Observatory was built in 1818; the Madras Literary Society dates back to the same year. The beginning of the trunk roads was in 1822, in Sir Thomas Munro's time; the Madras Club was founded in 1832; the Medical School in 1835, and a Chamber of Commerce in 1836. The Christian College of the present day, that has so much to do with education under its veteran principal Dr. Miller, had its beginning in 1837. A Madras "University" was opened in the College Hall in 1841; the University as an examining Corporation was created in 1857. In 1842 the first Peninsular and Oriental steamer called; the esplanade lighthouse, was built in 1844, previous lights having been in the fort. The first telegraph line was from Madras to Poonamallee in 1854. The Mutiny led to the raising of the Volunteer Guards. The pier for landing and shipping, not through the surf, was built 1859-61. The Duke of Edinburgh visited the place in 1870, the King (as Prince) in 1875 laid the stone to commemorate the harbour works, then about to be commenced; the Duke of Clarence's visit was in 1889. There was through railway communication to Bombay in 1871, to the south-west coast in 1861, and to Calcutta in 1901: the South Indian Railway ran through south to Tuticorin in 1879. The beach batteries were built in the same year. An era of public buildings coincides with Sir Mountstuart Grant Duff's administration, 1881-86—the Victoria-hall, the post and telegraph offices, the Gosha and Ophthalmic hospitals, and the Marina. The new Law Courts were completed in 1892; the lighthouse atop is 166 feet above sea-level, and the light is visible at 20 miles. In Sir Arthur Havelock's time the Moore Market was opened and large improvements made to Government House. The chief public works of the near future will be a Government office, collecting as many public officers under one roof as the want of a thoroughly satisfactory site will permit, and a Presidency jail. There has been a deal of private building of late years in the way of new shop premises along Mount Road, and small dwelling-houses are breaking up the old spacious compounds of Egmore and Nungumbankum.

As affording individual opinions, in 1810 we have Mrs. Graham writing enthusiastically:—"The town and fort are like a vision of enchantment. The public offices and store-houses are fine buildings. The English at Madras have a great deal more of external elegance than at Bombay, but the same influences operating in the Society I find it neither better nor worse." And she refers to the army and civilian jealousies. It was the fashion for ladies and gentlemen to repair in their gayest equipages to Mount-

road, and after driving furiously along it to loiter round and round the Cenotaph for an hour, "partly for exercise, partly for the opportunity of flirting and displaying their fine clothes." Visiting went on from 9 a.m., and till tiffin was over. Mr. James Wathen about the same year visited Madras from July to September—far from the best time of the year—and is charmed with everything from the appearance of his lovely country women in the dance to the dignified conduct of the Governor. At the service in the fort church he found the ladies occupied the nave; the Company's naval officers were in one aisle and the military officers in the other, all in full uniform; and in spite of the punkahs the heat made his situation "almost intolerable." He parted from the place in acute melancholy, for he had never been so kindly entertained, and that by Hindus, Mussulmans, Persians, and in particular by his own countrymen.

The assembly at the Cenotaph—at the fourth milestone of the Mount-road—persisted for long. A later picture than the above is of five o'clock of an April afternoon, a troop of civil servants riding, puffing, panting, perspiring, habited in broad cloth great coats closely buttoned and wearing top-boots, going to dinner in a tent near the long tank. A Judge is driving a spirited horse seated in a lofty car "like a demigod," dressed in a first-class box-cloth coat, cape and all. In the town the narrator sees a dashing pair of horses, dragging a lofty curricle bearing the Postmaster-General, again in a great coat coming down to the heels, but thrown aside over the right knee to show a new pair of top-boots; the lady in warm looking pelisse with the addition of a fur tippet, her hands and arms buried in a brown coloured hair muff. It is a great thing to be in the fashion; in my later time I have known men who wore heavy European garb, because, they said, it was coolest, but most of us nowadays find the lightest clothes a burden in April.

The letters of a lady about 1837 describe dinner-parties as rather dull, grand, and silent, all tired with the heat and work—this in January; the houses greatly infested with mosquitoes; people talk a little to those next them in a very low voice, but one scarcely ever hears any topic of general interest save steam navigation and the changes in the service. After dinner the company sit round in the great gallery-like rooms, and talk in whispers; sometimes there is a little music as languid as everything else. "The ladies are all young and wizen, the gentlemen all old and wizen. Every creature seems eaten up with laziness." She is young and full of life and curiosity; goes to a native entertainment and describes it; the house got up as a French lodging-house—dancing girls, conjurers, and a great supper. As to the appearance of the place, she says it is flat plains of sandy ground, covered with a little harsh dry grass, half-cultivated gardens with high hedges, and large dilapidated houses. In general there is very little beauty, either of architecture or scenery. However, she says, Madras is not considered a good specimen. Madras, certainly, is not at its best in February, especially after a short monsoon; dinner parties are anything but stiff or dull now; the topics of conversation are not limited, the company no doubt being more diversified than in her day; and the mosquitoes can be kept under by kerosene on their breeding places. Gardening is a favourite occupation with many; every house has its surroundings of croton and other foliage plants and shrubs. Roseries and ferneries are common. Some are able to put down attractive lawns; and in the cool weather with care and attention flowers are in profusion. The water supply and the easy procurement of seeds and plants have, of course, made all this a much easier matter than it once was.

I have said little of the native population for the best of reasons. One may go to a wedding, to an entertainment of a Governor or Viceroy, and meet native gentlemen in public or social work or in full friendly intercourse. All this does not justify pronounced opinions on social questions or matters among them. Manners and many things else have altered much in even my 35 years; the old men of my young time could be friendly and reserved at once, and clothed themselves in the flowing garments of their country looms, with their feet in sandals if in anything. Now, manners and opinions are free; the cloth coat, probably trousers and patent leather shoes are the integuments of most that can afford them for full dress purposes. The flannel jacket is not despised either. They are building and furnishing houses on European lines; the long armchair is everywhere; indeed, a *rapprochement* in idea and in action as in the English tongue is progressing rapidly. A Cosmopolitan Club exists in Mount Road; societies of all sorts for political, religious, charitable, social, moral, mental, and physical ends are numberless—I note even a Sir Henry Irving

Association. With so much mental activity called into being by education, the objects and uses of these associations will increase and extend more and more. I see an improving standard of action in public life in inreasing volume, and there is in Madras but little of the professional unworthy agitator—a contrast with some places greatly to the credit of Madras.

The Black Town is now George Town in commemoration of the Prince's visit in 1906, and in deference to native sentiment. It is about two square miles in area, ill-built, densly populated, poorly drained, the chief business part of the city; and it contains the High and other Courts and the Law College, the mercantile offices, the Madras and other banks, the Post and Telegraph office, the Custom House and Collectors' offices fronting the harbour; the old Mint, now the Government Press, and other Government offices, with various uses; the Madras Railway Central Station, the General Hospital (among the best in India), and the Medical College; the Memorial Hall, founded in 1861, in thankfulness for escape from the Mutiny, Pacchiappa's hall and Educational buildings, the Christian College, with its hostels, the Municipal office; St. Mary's Roman Catholic Cathedral, the Portuguese and Armenian churches, all of considerable antiquity, and other churches and chapels. There is no lack of places of worship throughout Madras. The fort and its glacis are outside municipal jurisdiction, and the Military Department have powers over a certain range surrounding the fort.

Proceeding with a rapid survey of the city by blocks, we have on the north Tondiarpett, the Tandore of the old times, between the sea and the Buckingham Canal. The East Coast Railway runs on its south and west. It contains cotton mills, the Leper Hospital, the Monegar Choultry for the native poor and incapable, dating back to 1782, various churches and mission houses, the Emigration Depot and the Robinson park. Washermanpettah, one of its villages, carries us back to the time when the Company's bleachers found it advisable to move there from the fort neighbourhood on account of the better quality of its water. To the south-west lies Perambore, bisected by the South-West Railway, with Viyasarpadi on the North Trunk-road; the Buckingham and Carnatic spinning and weaving mills, the Madras Arsenal workshops, and the salt stores of Government, supplied by the Ennore group of factories and in connection with the railway, are on the south and east.

Southward of Perambore and north of the winding Cooum, are Vepery, Purusapakam and Egmore. On the east of the block is the People's Park, due to Sir Charles Trevelyan, and 116 acres in extent, having, on the south of it, the Moore General Market, which cost about three lakhs, and the Victoria Hall, the idea of which originated with Sir Arundel Arundel, and released from debt the other day by the Raja of Vizianagram; in the middle of it is a small zoological garden. The Penitentiary—the Madras jail—is across the road on the Cooum banks, not unhealthy in spite of its too frequently odoriferous neighbour. Then come the Gun Carriage Factory, the Electric Tramway offices and power station, the Doveton College and Girls' School intended chiefly for the Anglo-Indian community, an animal infirmary, the Government Veterinary School, the S.P.C.K. Mission Press, St. Matthias and other churches. Vepery is pre-eminently the Eurasian quarter. On the extreme west in Kilpank is the lunatic asylum, in the south-west the orphan asylums. Crossing the Poonamallee-road, traversed in 1751 by Clive with his small band of 500 and a few guns to take and hold Arcot, there is the Friend-in-Need Society's premises for the European and Eurasian poor and infirm, started in 1807; the School of Arts which, with little success, has endeavoured for fifty years to imbue the country with English ideas of art, and will find any *métier* it has in teaching industrial arts and crafts; St. Andrew's, or the Kirk, built by de Haviland 1818-21, its steeple, 165 feet high, a fine piece of architecture, but defective acoustically; the Government Maternity Hospital dating back to 1844, and the Ophthalmic Hospital to 1867, both excellently housed and doing splendid work; and the Government Museum, Connemara Library, and Victoria Memorial-hall—the first established in 1851 and intended to illustrate the natural history, natural resources and manufactures of Southern India, and the manners, customs and antiquities of its inhabitants, with a most interesting coin and arms collection, and remains of Buddhist sculpture from Amararati; the second with a growing library and excellently furnished, both under the gifted and genial Mr. Thurston as superintendent and curator. The Victoria Technical Insti-

tute is materialising at present in the Memorial-hall, the foundation-stone of which was laid by the Prince last year. It is proposed to use it for a permanent exhibition of the best specimens of the arts and crafts of South India, for sale and for exemplars; the theatre or lecture-room in the Connemara Buildings has not yet found its intended use, but may when the scheme of technical instruction is settled and at work. The South Indian Railway traverses Egmore east and west along the banks of the Cooum and the fort glacis up to the beach station at the harbour, being there linked up with the Madras Railway. A new station is in hand at Egmore.

Nungumbankum, described in 1708 as under Egmore, is mostly remarkable as containing the Observatory and many of the fine old garden houses. The Observatory dates back to 1792, and is due to William Petrie, Sir Charles Oakeley, and the Company. It is chiefly occupied now with meteorological work and keeping the time for India, the Observatory for Solar Physics having been transferred to Kodikanal, on the Pulney Hills. The office of the Director of Public Instruction—formerly the old college—is near it on the Cooum bank, and the Madras Literary Society owning some 45,000 volumes has recently been provided with a new building adjacent. In the south-east on Mount-road is the Elphinstone Hotel, once the Amir Bagh, and later the "Choultry Plain" from which the Commander-in-Chief used to issue his orders.

Next may be taken the division east of Egmore and Nungumbaukum, south of the North Cooum and the fort, and north of Peter's and the Ice House Roads, being the Island, Chintadripett, Triplicane, and Chepak. The bodyguard lines, camp equipage depôt, and the English, Scotch, and Roman Catholic burial grounds, occupy the west side of the island; the rest is given up to parades and to sport, the Gymkhana Club for racing, polo, football, and golf, having a pavilion there. Munro's equestrian statue by Chantrey stands in the centre. South of the fort is or rather was Cupid's Bow, the meeting place of rank and fashion when I first saw Madras; I remember my companion being invited by the Governor's A.D.C. to understand that a bowler hat or its equivalent was not in order there in the evening. Chintadripett was founded for weavers in 1734; I heard Lord Napier say it was simply St. Andrew's pett; if so, the Kirk is not responsible. The park named after that Governor, 24 acres in extent, is a great boon to a squalid quarter.

In Triplicane, Government-house requires more than a passing word. The garden-house—by which may be understood a good roomy habitation with a considerable area around it—is a distinctive feature of European Madras, and I do not hesitate to say has increased the average of European life there. The dweller in Calcutta cannot profit by looking from his office or bedroom window on his cook or horsekeeper at their daily avocation, although his proximity may stir them to industry. Some garden houses boast a golf course in their own grounds, the generality of them have a few acres. What was probably the first—the Company's Garden-house—was built in 1681 on the site of the present Medical College and General Hospital; Paradis' plan seems to exhibit it and others; Governor Gyfford and his successors put in a deal of time there, but the French occupation made an end of it. Comparing maps of 1798 and 1823 to be found at the India Office, assuming the first to be complete, it would appear that there was a large addition to the number between those two dates as well as much bridge building and other improvements. In 1753, a house on the site of the present Government-house was acquired by purchase; the French occupied it in 1758, and it suffered accordingly. Thereafter it was improved and extended, the Triplicane road turned aside, and the compound enlarged. Lord Clive found it too small for his needs, appointed the Company's astronomer, Mr. Goldingham, a special engineer for the Company's buildings, made the Government-house to his mind in 1800-01, and built the Banqueting-hall in 1802. The Company were far from pleased at the adoption of "the ostentation of native Governments . . . . . the expense to which such a system would naturally lead must prove highly injurious to our commercial interests." The house improvements cost 106,000 pagodas, the hall 74,000. The latter covers a space of 203 by 111 feet; the room itself is 120 by 65 feet, and 40 feet in height; it was inaugurated on 7th October, 1802, the day being appointed one of thanksgiving for the restoration of peace, and His Excellency gave a breakfast and a ball. It is a building that impresses by its size, though Bishop Heber had not a good word to say for it, and its utility for display and social purposes is beyond question. Its walls are getting overcrowded with pictures. Budgets and Finance Secretaries put a swift and sharp curb now on "ostentation" and foot no bills that cannot

show sanction for the expenditure, so we may not look for a third Lord Clive; but Madras, not to speak of India, owes thanks to those that lived and governed as seemed good unto themselves. Guindy Lodge acquired in Sir Thomas Munro's time is the lineal successor of the Company's Garden-house of 200 years ago.

Wade's statue of King Edward the Seventh stands outside the gates of Government-house in Mount-road. The Nawab Mohamed Ali, dubbed Walajah and made independent of the Nizam in 1765, found Madras a safer or pleasanter place than his own capital of Arcot, and at one time wished to put up in the fort, but built himself a palace at Chepak in or about 1768. When Government stepped in and pensioned off the family in 1855, the land and buildings were bought in auction by Government, and enabled the Government-house compound to be extended to the sea, provided a site for the Senate-house with its magnificent hall, and gave offices to the Board of Revenue and the College of Engineering. At the south end of the Senate-house is a replica of Boehm's statue of Queen Victoria. The Public Works Secretariat, the Presidency College, the Chepak Cricket Ground, Victoria Students' Hostel, and the Gosha Hospital occupy the rest of the Palace grounds, and the Prince of Arcot now lives in the Amir Mahal in Royapetta a short distance from the Madras Club. General Neill's statue stands in Mount-road in a line with the club. He fell at the relief of Lucknow and the glory of him and of the Madras Fusiliers, as of many more, will not fade while the world has any memory for gallant deeds.

The Marina owes its existence to Sir Mountstuart Grant Duff. It runs from the Napier Bridge to San Thomé about two miles along the sea face, and was the fashionable evening resort after Cupid's Bow. Of late it has somewhat descended in use, the gentler sex finding more welcome at the Madras Club than was once accorded, and having the full liberty of the Adyar Club and grounds. The Marina leads into San Thomé with its fine new Goanese cathedral, built in 1896 over the House of St. Thomas, in which he is buried according to legend; it has a steeple 155 feet high; the diocese was created in 1606. There are many more churches and various interesting old houses in San Thomé. The ancient Mylapore, the home of successful native lawyers, with a famous temple and tank, at which there is a gorgeous yearly festival, lies behind. Further west still is the Luz Church, carrying us back to the early days of the Portuguese occupation, when they became a light to lighten the Gentiles. The Luz road debouches on the Mowbray-road, with its famed avenue of banyan trees, leading from St. George's Cathedral road and the S.P.G. Mission premises to the Adyar Club. The coast road south from San Thomé winds past the Admiralty House, now belonging to Vizianagram, where Admiral Rainier entertained the Nawab in 1805, past Brodie Castle, the bridge built by Lord Elphinstone over the river, and the ford that gave passage to Paradis and his men to the rout of Maphuz Khan and his army while the English were prisoners in their own fort, and thence on by the Adyar Club into Mount-road. Then north along it under the long tank bund past where the Cornwallis cenotaph was set up to the Horticultural Gardens, with its rarities in trees and plants, landing finally at St. George's Cathedral across the road. It also was built by de Haviland, and opened in 1815, to serve the population that dwelt far from the fort. The lottery fund contributed to its cost, as it did also to the cost of the Kirk and to other pious and charitable projects. The padre of its early days is recorded as denouncing dancing; in this, at any rate, there was an advance from the state of the times wherein good Mr. Patrick Warner had seen it his duty to bring to the notice of the directors "the vicious lives of the soldiers and some of the writers in the fort," 140 years earlier. The appointment of Bishop Corrie made it a cathedral, and Madras is proud of it.

I have spoken of the railway communications of the city. I should also note that the completion of the Buckingham Canal made a water-way from the Adyar into the Cooum, and thereby the Merkanam back water was united with the canals of the Godavari. One beneficial result must have been a readier and cheaper firewood supply from the plantations along the coast.

A word is due to the tramways. I believe they were the first electric ones in India, but they were not a profitable investment to their first shareholders. The original underground working had to be abandoned for overhead wires. They run now from the power station at Egmore to the harbour, around Vepery and into Purusawakam, through Chintadripett across Mount-road into Royapett on one hand and through Triplicane to Barber's Bridge in Mylapore on the other. Extensions are in progress. Needless to say the tramways are a

great convenience to those not served by the railway lines.

A contract for the electric lighting of part of the town was in contemplation when I was last concerned with the municipal administration, and that work may now be in progress. Telephonic communication is maintained for Government purposes, and is available for private parties who are prepared to pay for it.

The harbour is 1,000 yards square of the sea, enclosed by two arms run out from the shore doubling in towards each other and leaving an eastern entrance of 550 feet. It was approved in Lord Hobart's time; work began in 1876, and what was done was destroyed in great part in 1881 by a cyclone. It was started again after some time and, in a way, finished. The purpose was to make landing and shipping easier than the open surf permitted; safety on the Coromandel Coast is by skilled navigation through the storm. The results of damming the up and down currents of the ocean are a large and extending accretion of sand on the south, and coast erosion on the north, with considerable silting up of the enclosure. It is now proposed to revert to what I believe was the original purpose of a north-eastern entrance protected by a north-easterly arm and the closure of the present mouth. This is now in execution. Interior dredging is a necessity, and can be done with the powerful appliances of the present day. Ships are berthed throughout the basin; some can be laid up against the north groyne. The old steel pier is in the middle and in full use. Mr. Spring, the energetic and capable chairman of the Port Trust, is making improvements by new pier and crane provision for the speedier working of both imports and exports, by a seven-acre boat basin, so that more effective and valuable lighters may be introduced and worked without risk of damage to them from bad weather, and also by shedding adjacent to the piers to admit of speedier Customs disposal. The hope, of course, is of a larger trade by cheaper freights. The expenditure that has taken place and that now embarked on will, I imagine, be well over two crores. The tonnage of shipping using the port in 1905-6 was 1,519,240; it is continuously increasing. The import and export dues in the above year were Rs. 6·55. The export trade seems stationary; the improvement is in imports. The value of imports and exports was Rs. 137,127,619; the chief imports were apparel, cotton twist and yarn, cotton piece goods, grain and pulse, liquors and kerosene oil; and the chief exports, raw cotton, cotton piece goods, hides and skins, indigo, oil seeds, and ground nut. With no natural advantages of situation and as only one of several coast ports, it is not in the nature of things that trade and the staples of trade should converge at Madras as at Rangoon, Calcutta, Colombo, Bombay, and Karachi. The harbour has satisfactory uses at present, however the future may treat it, and the trustees are wisely making the most of those uses.

The administration of justice in Fort St. George in the beginning was by the fourth-in-Council, styled the Customer, who conjoined the duties also of buyer and of receiver of rents and customs. He had, for colleagues, the mint-master and the paymaster, and his court was in a building at or near the choultry gate. These Justices of the Choultry did not give satisfaction and could not overtake all the work, and in 1678 the Governor and Council determined to sit twice a week in the chapel-room to deal with the important cases.

In 1683 the Company had obtained Letters Patent for the establishment of a Court of one person learned in the civil laws to hear and determine all suits and causes with the assistance of two merchants—judgment to be according to equity and good conscience and the laws and customs of merchants. This person duly arrived, being Sir John Biggs, formerly Recorder of Portsmouth, was styled Judge Advocate, and what was called the Court of Admiralty was established. A chief object in view was the summary punishment of interlopers. An occupant of this office in 1694 was dismissed for bribery and for applying the statutes of limitation in favour of ex-Governor Yale and against the Company, but it was ordered that "due respect be given to a person of his quality and abilities in consideration of which it is a trouble to us to part with him." His offence must have been flagrant.

In 1688, when a Corporation of Mayor, Aldermen and Burgesses was appointed by the Company's orders, it was directed that the Mayor and some of the Aldermen should be Justices of the Peace and try cases, appeals lying to the Judge and Judicature of the Admiralty: in civil causes the appeal was to the President and Council. Every Englishman was to be dealt with for crime by the President or some English Justice of the Peace and not by any foreigner. A Recorder

is mentioned in the list of officers present at the institution of the Corporation in the above year, but disappears till 1798. Later, in 1688, the Mayor's Court was directed to meet once a fortnight, and Aldermen were to sit as Justices of the Choultry for petty cases twice a week, leaving the heavy cases for the Mayor's Court. Captain Hamilton's opinions on the administration of justice are very far from complimentary to the judiciary. The next reorganisation was in 1727 under letters patent; a Mayor and nine Aldermen were empowered to deal with all civil causes, with the President and Council as a Court of Appeal. The five Justices of the Peace named in the charter had the petty criminal cases as Justices of the Choultry; the President and Councillors were empowered to hold quarter sessions for all serious crimes save high treason with jurors and procedure apparently as in England. A Sheriff's Court was created with summary and ordinary powers, appeal lying to the Mayor's Court. The Sheriff was a new officer; the first appointed was the junior of the Council; he was in the inaugural procession "with a white wand, on horseback." He seems to have been vested with powers in criminal cases, but in 1729 these were withdrawn by the Company's orders. This charter was repeated in 1753, with the addition of a court of requests or of conscience for small causes. The President and Council were to create the court by appointing not less than eight nor more than twenty-four of the principal inhabitants as Commissioners.

In 1772 provincial civil and criminal courts were established for the Mufasal territories, and in 1802 the Sadr and Foujdari Adawlats were instituted as Chief Courts for the Mufasal at the Presidency.

In 1798, Sir Thomas Strange arrived as Recorder and President of the Mayor's Court of Madras town, and in 1801 became Chief Justice of a Supreme Court, with two Puisne Judges, which absorbed the Mayor's Court, and also the judicial powers of the Governor and Council so far as the town was concerned. The jurisdiction of the Small Cause Court was extended. The Supreme Court originally sat in the fort; later it moved to a house in Bentinck's buildings in the town on the sea face, and again into what were the Board of Trade buildings. Its territorial jurisdiction was, roughly, the city area; European British subjects in the country had their privileges under it. The Adawlats, latterly at any rate, occupied the Sadr gardens in the Luz. These Chief Courts were fused into the Madras High Court in 1862.

The minor administration of Criminal justice at the present day rests with the Presidency Magistrates; of Civil justice, with the Courts of Small Causes and the City Civil Court.

Police work was first performed by the Pedda Nayak and his peons, 20 in 1640, 50 in 1659, paid by *inam* (rent free) lands and by certain petty duties on comestibles. The chaplain was made secretary of a Police Board which was created in 1770, and a police court seems to have been established in 1798. The office of head Nayak was abolished in 1806, and the town police formed; and it has been remodelled from time to time since.

The history of municipal government is interesting and definite throughout. In 1675 and 1678 attempts were made to tax for improvements to the fort and keeping the town clean, but the assessees refused to pay, as they had thitherto sat tax-free and would not have that custom broken. In 1682 Child had given the council to understand that the revenue of the town must defray at least the whole constant charges, and in 1684 they half-heartedly settled to levy a small monthly tax "which if they (the townsfolk) so oppose as formerly that we cannot be successful then to offer it (propose it) as a voluntary contribution to all the inhabitants of the town, which possibly may have a better effect upon their wilful tempers." The Caste Headmen protested, but finally agreed to a graduated house tax. In 1686, however, in spite of soft words and arguments, the people broke out in mutiny, ordered the cessation of labour and service, the shops to be shut, and the bringing in of grain to be stopped, "insolently declaring that they would continue their rebellion till they were freed from the said present and all future taxes." The Council set out its soldiery, threatened confiscation of goods and house sites and eternal banishment; and firmness produced discontented submission. The Council must have been unhappy, for, six months later, Child's trenchant pen may be recognised: "This *pro* and *con* between us and you will never end well. Pray let us have no more of it. A revenue we will have *aliquo modo*, for that infinite charge we have been at to raise that town—which hereafter we shall call a city—from so despicable a condition as it was in when we settled there. . . . With your leave, we will have a ground or quit-rent yearly for every house within your precinct, and a small poll-money for every head."

In 1687 Child drafted a Corporation, for the Council's consideration, of aldermen and burgesses, who were to choose their mayor yearly, "Natives, mixed with some English freemen . . . to tax all the inhabitants for the public good, and to be so managed as to make them proud of their honour and preferment, and yet only ministerial and subservient to the ends of the Government, which, under us, is yourselves." Gowns, scarlet and black, umbrellas, maces—"silver gilt not exceeding a yard in length"—officers, and fees, were all suggested. He did not, however, wait for their opinions; orders followed in three months, and in 1688 the Corporation was in full working order. Their success as exactors and appliers of taxation was not very notable, but in 1700 they were able to levy 1,051 pagodas from the inhabitants of Black Town for a wall and other defence works. In 1726 a general survey of tenements not already under *cowle* (grant) was ordered, with a view to a better proportioned assessment and to improve the revenue from quit rent and the scavenger's duty. The town was reported on by committees for each of the three divisions. The prevailing note of the reports is the great poverty of a large proportion of the inhabitants; in Muttialpett with 1,403 houses there were not ten worth 300 pagodas each. The reporter on Peddanaikpett has a dismal tale of the foulness of the place and of street encroachments—the latter a feature of urban life throughout the Presidency that persists to the present day in spite of penalties under the law. The purpose of improving the revenue was very little served. Prior to 1735 what was called the Town Conicopoly's duty was appropriated to the repair of bridges, but the directors ordered it to be passed to the credit of their revenues and the council fought shy of special assessments or tolls, preferring when the bridges had to be repaired to charge it to general revenues.

Acts of the Georges gave powers to the Justices of the Peace assembled at General and Quarter Sessions to arrange for the cleansing, watching and repairing of the streets of the Presidency towns, and to levy a house and land assessment. A string of Acts of the Government of India and of the Government of Madras from 1836 onward, sanctioning increased and extended taxation, appointing paid Commissioners, associating honorary Commissioners with them, creating divisions of the city and local representation, directing provision for education, hospitals and vaccination, introducing the elective principle and extending it, lands us finally at the present Act III. of 1904. That was framed somewhat on the model of the Calcutta Municipal Act, and created a representation of 20 elected ward Commissioners, one for each ward, of eight more nominated by public bodies—the Chamber of Commerce, the Trades Association, the Harbour Trustees and the Railways—and of eight nominated by Government. The standing committee—the working body—consists of eight members and the President, composed so as to produce the Corporation constitution in miniature. Amplified borrowing powers were given; the maximum of taxation on lands and buildings increased from 15½ to 18¾ per cent., and improvements on the prior law in various respects and specially in the regulation of buildings were introduced. The voting qualification, so far as it is monetary, is payment of a particular taxation of Rs. 20 per annum or householding to that value per month, while Commissioners must be of the male sex, twenty-five years old, acquainted with English, resident in or within two miles of the city, paying Rs. 100 per annum in taxes or occupying a house of the annual value of Rs. 1,200. For the introduction of the Act the lists showed 441 persons qualified to be municipal commissioners, and 6,524 qualified to vote at elections. Sixty-five per cent of those qualified to vote did so at the first elections.

Profession tax, animal and vehicle tax, and tolls are imposed as well as the house and land taxes. These in 1904-5 yielded about 11·50 lakhs; other receipts made up an income of 17·14. They spent on public new works 6·29 of which 5·86 was for drainage, on repairs 5·04; on education ·07 apart from the Government subsidy; on hospitals and dispensaries, vaccination, registration and conservancy 4·16; on lighting, markets, avenues, parks, &c., 2·26; for supervision ·94. Sinking fund payments aggregated ·75, and interest on 60 of debt was 2·63. The sinking fund accumulations amounted to 18·43. The Corporation has been able to borrow for the past ten years at 4 per cent.

The works that have tried its finance and engineering abilities are, as may be supposed, water supply and drainage. Over thirty years ago two irrigation tanks beyond the Red Hills—a lateritic outcrop eight miles from the fort—with a combined water-spread of ten square miles were taken and strengthened; a supply channel was cut from the Kusastala

(Corteliar) river nine miles north of the Red Hills tank to convey flood water to increase the local rainfall supply; the amount for irrigation from the tanks was restricted, and the surplus made available for Madras by gravitation along an open channel to Kilpak, whence it is distributed in pipes throughout the town. When the lake level falls to about 36 above mean sea-level pumping has to be resorted to in order to pass water into the channel, and this happens late or early after the north-east monsoon according to its copiousness or otherwise. It is not an ideal supply or delivery by any means, but is a great advance on the old well supply; its defects are possible deficiency, lift from the tank bed, local fouling, non-filtration and lack of pressure which, in particular is now causing fouling of the distribution pipes. It is in view to take off from the lake at a lower level, to cover in the supply channel, provide filter beds and lift the service at the city delivery to secure pressure and a wider distribution. The supply of 1904-5 was 625,000,000 cubic feet—a rate of about 20 gallons per head per diem but so much never reaches the individual. The scheme under present consideration is for a population of 660,000 at 25 gallons per head per diem. And the cost of it will not be less than 25 lakhs, while a thorough distribution service will mean a good deal more.

The drainage of 27 square miles of land but little above sea-level is a more difficult business. Since sewage is properly transmitted only underground and the question is one of slope the problem requires no further statement. There has been no lack of advice or of schemes. The plan finally adopted was to deal with the city in sections, pumping on to sewage farms, and Black Town was so treated in the eighties at a cost of about ten lakhs. Five other sections have been undertaken, and the present purpose is to collect the sewage in each division at a well and lift it by pumping into a main that runs from Mylapore, through Triplicane, Chintadripett, the People's Park, across the railway and the canal, and over the Trivetore High-road to the Tondiarpett Farm, which is intended to receive the whole flow. At the present moment the sanitary authorities have condemned the execution throughout; the Corporation is not disposed to accept this judgment without further evidence, and is taking time for more observation and for local experiment. The points for notice are that the gradients of the main are seemingly insufficient for proper onward movement, and that the tota execution has so lagged that already the provision is behind the time. With a largely increased water supply in near prospect and a twelve per cent. increase of population every ten years, it behoves those concerned and responsible to see that their duties towards the present and a near future at least are passably fulfilled. Till the present time 31·4 lakhs have been expended out of an estimate of 48 lakhs; now it is conjectured that 85 lakhs will be the total cost of a proper service. It is impossible for Madras to undertake work of such magnitude out of its own resources; past errors are due to its having to cut its coat according to its cloth and to restrict its output of work to the funds available. The Supreme Government controls the only purse that is equal to such occasions, and it instructs the local Government that local municipal wants are debitable to local municipal income. The principle is excellent; wisdom has regard to the particular instance when it is sought to apply any principle.

The health of the city varies largely from year to year. The congested parts naturally suffer in comparison with the free and open blocks on the margins and in the south; epidemics when virulent alter normal figures largely; and scarcity outside will cause an influx of bad lives and swell the death-rate, while a heavy monsoon will log the soil further and set up fevers. The average birth-rate is fairly constant, being around 40 per mille for the ten years 1894-1903; for the same period the deaths average 41 because of large excesses in the rate in three years. And for 1905-6 the birth-rate was 45·6 and the death-rate 59—the largest on record save for the famine year 1877, when it was 117 per thousand. There were outbreaks of cholera and small-pox and a large infantile mortality in 1905-6.

Plague has been most successfully combated —it may be said kept out—till very recently, and even now cases are few; the dealing with it is both worrying and expensive.

The continuing increase of population is due to immigration. The proportions of race are 806 Hindus, 113 Mussulmans, and 80 Christians in a thousand, and of literates, that is of those that can read and write a letter, 360 in 1,000 males and 91 in 1,000 females, as against 119 and 9 for the Presidency.

The mean rainfall over 90 years is 49·11 inches per annum, mean temperature 82°, with extremes of 64° and 108°. In May and June,

said Thomas Bowrey in 1688, it is "something sulphurous," but perhaps August and September are more trying by their damp heat.

Recent visitors to Madras have spoken of it in kindly fashion. The character of the place and of its people could not have been more cordially recognised and appreciated than by its Royal and many visitors of last year, when Lord and Lady Ampthill did the honours of the Presidency magnificently and gracefully. Still the carping critic of the North will talk and write of it as "a pleasant backwater," "a country that needs no talents in its administration"; and five years ago the Society of Arts was informed that "there is no city of Madras, only an obsolescent maritime cantonment with no future and consequently no past of the slightest interest." My heart sank at the nature of the instruction you—once at least—have received. I would fain make no contrasts, but Madras has no mighty river flowing past, no supremely fertile soil adjacent, no splendid bay, no hills to look up to or from. She has achieved what men and nations struggle for—peace and prosperity; a contented people, a Government that busies itself with adjusting land and other taxation equitably, improving the conditions of life, developing the resources of the country, and adding to the revenues of the Empire to help it towards the same goal: pleased if she is now and again permitted to retain for herself a little more of the large revenues she affords. In irrigation and in many things else she has set object-lessons to the Empire; if others have bettered the instruction they have to thank their larger opportunities. I am travelling away from the City of Madras, but the city is the microcosm of the Presidency, and houses the Government for half the year. The city is loyal, and is not asleep; it thinks and speaks without shouting *Bande mataram* or other ridiculousness, with a sobriety and common sense to be envied and imitated. Neither Day nor anyone else of his time looking on that starveling spit of grey sand, on the wretched Cooum—with a bar that closes from February to October if a cyclone does not open it—and on the tiny villages dotted about the flat infertile plain towards the west, could have dreamt of a future when over half-a-million would dwell there pursuing industrious callings, provided with the civilising agencies which this century affords and with no Nayak, Nawab, Nizam, or Great Mogul to make them afraid. The storm and stress of war, glorious and inglorious, has gone long years ago; a struggle of another sort is now afoot in Madras as elsewhere, to be dealt with by statesmanship not by battalions, for the settlement of which self-reverence, self-knowledge, self-control on all hands are prime requisites.

To me the marvel of the city is that with so little granted by natural position so much has been accomplished. Destitute of the usual foundations of a great city she is still the third in India, and the fact says much for the strong hearts of her makers and begetters. In trusting that she will continue to flourish I am certainly voicing the wishes of all that have had a home there and have kuown her as she deserves to be known.

DISCUSSION.

The CHAIRMAN was sure everybody present would agree with him that they had listened to a highly interesting paper. He had been particularly struck by a remark made by Sir James in his closing sentences concerning a former paper read to the Society. He did not know who the author was, but he had apparently said that there was no city of Madras. Sir James Thomson had stated that Madras was still, as regards size, the third city in India, and he believed he was right in saying that it was, in that respect, the seventh city in the British Empire. It was quite possible, from one point of view, to assert that there was no city of Madras. If one ascended to the top of the Law Courts, the highest point in the town, and looked round, no city could be seen; the aspect was was more like that of a forest than that of a city. From that point of view, and that point of view alone, it was possible to assert there was no city of Madras, so luxuriant was the vegetation which constituted one of the principal charms of Madras. The author, as was right and becoming to one who read a paper to a learned Society, had filled it up with a great mass of historical, archœological, and political matter; and, interesting though that was, it could not give anyone an idea of the charms of the city of Madras; indeed, it was impossible for anybody to realise those charms unless they went and saw for themselves. He was not speaking in the spirit of the Scotchman, who, after travelling all over the world and seeing its great sights, declared that in his opinion there was still no place like Peebles. He (Lord Ampthill) was not a native of Madras, but still he said advisedly, having lived there for five years, that there was no city in the world for which he had a greater or more real affection. Places were judged not only by their natural charms, but also and more particularly by the people that inhabited them. He need say little of the European society of Madras, for English people are the same all the world over, but he would like to pay his tribute of affection to the Indian community. The nature of the people of Madras was never more

clearly evidenced than when their Royal Highnesses the Prince and Princess of Wales paid a visit there. It was a scene which he personally would never forget. Every coign of vantage, every inch of road, was crowded with a happy throng, on whose faces genuine pleasure and delight were depicted. He had never seen any crowd anywhere which displayed such genuine good humour, contentment and happiness as the crowd at Madras did on that occasion. But that was not unusual. If one drove through the crowded bazaars of Madras, it was generally noticeable that the mass of the people had smiling and contented faces. Of course, poverty and misery existed, as in all great cities, but still the general impression a visitor took away if he went through the crowded quarters of Madras was, that the population was as contented as a large city population could be anywhere. In addition, he derived a very great pleasure from association, in many concerns, with the educated section of society. He could not detain the meeting by describing their views, habits, or customs; it would suffice if he reiterated what the author had said about them, namely, that they were the most level-headed section of the peoples of India. They possessed the qualities of common-sense, of moderation in public affairs, and of soundness of judgment more than any other class in India. The important thing to remember about Madras was that it was the first foothold of the British Empire in India. The paper did not afford any occasion for discussion; there was no room for difference of opinion in regard to matters which were purely description; but Sir Philip Hutchins, a former member of the Madras Civil Service who held the high office of a Judge in the High Court, was present, and he was sure the audience would like to hear whether his recollections of Madras, which no doubt were as pleasant as those which the author and he himself had retained, had remained fresh and green in his memory.

Sir PHILIP HUTCHINS, K.C.S.I., remarked that Sir James Thomson had dealt so fully with the subject that he was in some doubt as to what aspect of the question he could take up. The audience certainly would not wish to hear anything more about the ancient history of Madras; but, following the lead of their noble Chairman, he would venture to amplify what had been said about the present amenities of the city compared with the other Presidency towns and Rangoon. Madras did not possess a grand natural harbour such as Bombay had, nor had it any deep water river such as there was at Calcutta and Rangoon. That was a great handicap to its commerce, but if he were told that he must take up his permanent abode in any of those places, having some little knowledge of them all, he would, on the whole, choose Madras. Its climate certainly was warm, and it had no real cold weather, but neither had Bombay nor Rangoon. Although warm the climate was equable, and the hottest months were tempered by a pleasant and invigorating breeze from the sea, which began early in the afternoon and continued till about midnight. In addition, as the author had stated, Madras still enjoyed its garden houses, well-built commodious dwellings with wide verandahs, and walls faced with fine shell plaster which might very well pass muster as the finest white marble. And those houses were to be obtained at a very moderate rent, which was very far from being the case at any of the other places he had mentioned. In other respects also Madras was certainly a much cheaper place. Many of the gardens or compounds might even be worthy of being called parks; some of them, as the author had stated, having their own private golf links. There were many miles of excellent roads and lovely avenues of banyans chiefly, but of other trees also. There was fair boating on the Adyar close to the Sports Club, and along the many miles of road there was capital riding. Madras, certainly in his own time and he believed still, maintained its pack of hounds all through at least the cooler months. The servants of Madras were admirable. The best of them did not leave the Presidency, so that anyone who did not know Madras did now know how admirable the Madras servants were. As the Chairman had stated, the educated classes were loyal and intelligent, and were very agreeable companions; he had still very many friends among them. Last of all, there was the Madras Club, which, by general consent, was, and always had been, the very best in India. Perhaps some of those present had heard that Madras had had a very scornful epithet applied to it, and would, therefore, wonder whether what he was stating was strictly correct. He had already alluded to the absence of a perfectly satisfactory harbour. Madras had no land frontier involving frequent and costly expeditions, and the people were orderly and quiet. Therefore, in the circumstances, it was natural that the wheels of Government should run more smoothly in Madras than they did on the north-west frontier, or in the country of the discontented Mahratta, or of the loquacious and irrepressible Babu. In that sense, and that sense only, he was prepared to admit that Madras was a placid place; but that was a very different thing from being benighted. It might be thought that he was prejudiced on the subject, and he confessed his sympathies naturally were with his own Presidency; but he would call an independent witness. It would be remembered that, some few years ago, the leading newspapers in this country sent out special correspondents to the Delhi Durbar. One of them found his way to Madras; he investigated the disparaging epithet which had been used about the city, and, after saying very much what he (Sir Philip Hutchins) had said about the smoothness of the wheels of Government, he wrote as follows:—"Madras, therefore, deserves the happiness of a country which has no history. Our ultimate aim being the protection and well-being of the natives, the almost practical attainment of this aim has been secured in Madras, and has robbed our work

there of much of the spice and zest which excite enthusiasm. The administration has been brought to a state of easy-running which tempts less happy Provinces to gaze wistfully to the South." A country that could be so described by an independent critic could hardly be called "benighted." He would venture also to cite one other witness, no less a person than their noble Chairman, who, in some very felicitous words which he once addressed to his Legislative Council, said :— "We in Madras are happily free from any necessity of considering heroic measures of reform. The existence of any necessity for great reforms connotes the existence of great evils; and, satisfactory though it is to have great reforms carried out, it is a happier condition not to need them." As he had already said, the audience might consider him prejudiced, and he acknowledged he was biassed; but after five years' work in the Governor-General's Council, and a still longer period at the India Office, he was quite satisfied that Madras need not fear comparison, and had indeed a great deal to be proud of.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to the author for his admirable paper, which Sir James Thomson briefly acknowledged.

Sir STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., said it was not usual at the meetings of the Society to pass a formal vote of thanks to the Chairman; but he felt sure he was only expressing the feelings of all present in saying that not only they but the Society were very grateful to Lord Ampthill for his kindness in presiding over the meeting; and he said that, not only for the great majority of the audience, but also for that miserable section of it which had not the felicity of being Madrasees.

Mr. R. F. CHISHOLM, F.R.I.B.A., Consulting Architect to the Government of Madras (Retired), writes:—Sir James Thomson's much appreciated paper made those of his audience who had lived in the city again feel its pleasant sea breezes; but it was with a pang of regret I learned from him how serious an effect that same sea breeze seems to have had on the past and future of the city! Speaking of its harbour, Sir James Thomson said :—

"The results of damming the up and down currents of the ocean are a large and extending accretion of sand on the south, and coast erosion on the north, with considerable silting up of the enclosure," and again "interior dredging is a necessity." Further on Sir James says :—"With no natural advantages of situation, and as only one of several coast ports, it is not in the nature of things that trade and the staples of trade should converge at Madras as at Rangoon, Calcutta, Colombo, Bombay, and Karrachi."

This is the truth, and if the truth, why this vast expenditure? Was it because this truth gradually dawned on a section of the merchants of Madras some years ago that they sought at all hazards to commit the Imperial Government to this useless waste of money? If Madras could be made a port it would be the centre of trade for the richest districts in India; if, on the other hand, it could not be made into a port, the era of railways must sound its death knell. Madras may be the Brighton and the Oxford and Cambridge of India, but the port, never! It may stretch its northern arm along the coast northwards until it reaches Coconada, it may, in the mean time, fare sumptuously on the crores of Imperial expenditure sunk in the sea during the process, but if such a thing were really possible then Coconada would be the port, not Madras.

When I first became acquainted with Madras in 1863 it possessed one of the finest open roadsteads in the world. It was a favouite port of call for both ships and steamers trading with Calcutta; it was the centre of the passenger traffic for the whole of southern India. Being an open roadstead, the port dues were so light, that a vessel could touch even to get rid of a ton of cargo. For ten months of the year and sometimes the whole year, landing and embarking were perfectly safe. During the two cyclone months, May and November, the communication between the ships and the shore might be doubtful, but with proper precautions no ship should ever be wrecked. This bold statement requires explanation. I was present at the great cyclone of 1872-3, I forget the exact date, and saw sixteen ships wrecked. They were all driven on shore because they were lying within the line of partially progressive waves, and the successive blows from such immense masses of moving water no ship's cable can stand. One full rigged ship, the *Inverness*, anchored in about 11 fathoms, rode out the cyclone comfortably. I made a point of seeing the captain of the *Inverness* before she left the port, and he assured me that the cyclone was no worse than an ordinary bad channel gale. Few captains take into consideration this extra progressive action of the tops of waves on a shelving shore after a series of calms—the recent wreck of the *Berlin* on the Hook seems to be a case in point. If a powerful tug had been kept at Madras to tow ships to a safe anchorage during bad weather no well-found ship would have been lost.

It may not be out of place to explain briefly why a harbour cannot be made at Madras. The coast line consists of a broad belt of moving sand. Every particle of this mass is always in motion. In the south-west monsoon the particles move northwards, in the north-east monsoon, southwards, during heavy weather, in-shore, during calms, seawards, as all the particles are performing this catenary curve movement the coast line is maintained. Now, obstruct this movement in a line at right angles to the coast line, and during the south-east monsoon the south angle will fill up and the coast line north erode,

and during the north-east monsoon the north corner will fill and the south coast erode, and this is exactly what has occurred, accretion on the one side and erosion on the other. The expert who advised the Government admitted the probability of this action, but said that it was of a continually decreasing nature, and that before the sand passed round the end of the arm a constant would have been arrived at. This prediction has not been fulfilled. Not only has the sand worked round the outer wall, but it is filling the harbour which will "have to be dredged." It seems to be a reliable conclusion that if thirty years ago the effects as we see them now had been anticipated, no harbour would have been made, and although closing the central entrance and extending the north arm will materially lengthen the days of the harbour, what has been, will be, in spite of all dredging the harbour will close by silting, if some worse calamity does not seal the fate of the city, for it is quite possible for the erosion north to re-open the old backwater, and Madras may then share the fate of Mahavillapoorum, the submerged city higher up the coast which figures in Southey's "Curse of Gehenna."

THE BRITISH INDIAN COMMERCIAL MISSION TO SOUTH-EASTERN PERSIA.

I.

On account of the great importance of the report on Mr. A. H. Gleadowe - Newcomen's Commercial Mission to Persia, and the difficulty of obtaining copies, the following summary of the chief contents of the report has been prepared. The report has been printed by the Superintendent of Government Printing at Calcutta, and issued in the form of one of the usual Indian official publications, but the Indian Foreign Office have explained that the remarks and opinions are not official and rest on the authority of Mr. Gleadowe-Newcomen.

Copies of the report are said to be obtainable from the Upper India Chamber of Commerce, Cawnpore.

There is one point that must be borne in mind, and that is, that since the completion of the report, there has been a very marked movement in Persia (comparable with that in China, with whose circumstances Persia has several curiously similar points of analogy) in favour of "Persia for the Persians." This is not referred to by Mr. Gleadowe-Newcomen, but must affect the situation. Indeed it has already done so, so it appears, within the last few weeks, in bringing about the dismissal of two Belgian officials in charge of the Customs and probably of those in charge of the Posts as well.

The Origin and Objects of the Mission.

The genesis of the Mission lay in the fact that when the itinerary of Mr. Maclean, the Special Commissioner, appointed by the Commercial Intelligence Committee of the Board of Trade to inquire into British trade with Persia, was published in 1903, it was observed that the important mart of Yezd in Central Persia, and all the south-east part of the country were omitted. At the suggestion of Major Sykes, C.M.G., then H.M. Consul in Kerman, Lord Curzon determined on the despatch of a commercial mission to the region in question. Unfortunately no engineer was attached to the expedition, a regrettable decision as the absence of roads and the urgent need of the improvement and extension of irrigation would have made the observations of an expert valuable. The Upper India Chamber of Commerce and the Indian Tea Association Committee, lent assistance, and Mr. Gleadowe-Newcomen was appointed President, his colleagues being Mr. B. E. Luffman and Mr. P. F. Ryan, the latter acting as secretary.

The chief object of the Mission was—

1. An investigation of the present state of the trade of south-east Persia.
2. Examination of the hindrances to reasonable expansion of trade, especially with India, and of the causes of shrinkage.
3. How to expand Indo-Persian trade.
4. Introduction to Persians of Indian manufactures.
5. Collection of statistics.

The route as originally sketched by the Government of India was:—Northwards from Bander Abbas to Sirjan and Kerman and neighbouring tracts and thence through the Bampur Valley and Persian Baluchistan, Kuhak and the Kej Valley to Gwadur or Pasni on the coast, and thence home. As, however, there was no engineer attached to the Mission, it was decided that there was no hope of fostering much trade in the sterile parts, so a more extended tour was made in Persia proper as far north as Yezd.

The departure of the Mission took place on the 13th October, 1904, from Bombay for Maskat. At the latter port the party transhipped for Bander Abbas, where they arrived on the 21st October. Here the Mission appear to have been a good deal obstructed by the Belgian Director of Customs, notwithstanding the fact that special orders had been sent from Teheran for all facilities to be afforded. Things have since improved, for a British Consul has now been appointed, who is showing keenness in his protection of our country's interests.

Physical Features of Persia.

With the exception of a narrow sub-tropical strip along the coast, south-eastern Persia is a country with a fairly temperate climate. Even Persian Baluchistan and the terrible Lut desert are cool in the spring and autumn, and often cold in winter. In the low country (called the Garmsir), Jiruft, Persian Baluchistan, Bam-Narmashir, the Bushire plain and the oases in the lower and southern part of the plateau, tropical fruits, such as the date, lemon, and orange flourish, and even mangoes are sometimes met with; rice and tropical cereals are also grown. In the higher and colder regions, fruit and grain of the temperate climates succeed well.

The proportion of cultivated and cultivable land to wilderness and desert is small, however, and there are evident signs that it is steadily shrinking. Yet if irrigation, on a large scale and scientifically directed, were carried on, it would be possible to reclaim a considerable portion of this desert, for the soil is naturally fertile, though much of the water is brackish. Geographically, southern and eastern Persia may be described as a land of mountain and deserts. A few miles (15 to 30) from the sea coast, the great mountain ranges that rib Persia, raise their bare and splintered walls to the sky. Stretching their snow-capped tops, range after range, all along and across the land for hundreds of miles, they throw out great spurs which touch one another. Between the treeless ridges lie valleys, often of great length, some of them 30 and some 300 miles long, but seldom of any great width. Most of these valleys are capable of cultivation with the help of irrigation. In the gorges of the hills, and built along the banks of occasional streams, are rare villages, nestling in plantations of fruit trees. Other trees are scarce; what forest once existed has disappeared, and as a partial consequence, the rainfall, judging from the numerous dry river beds, has decreased. Rivers no longer flow except immediately after rain, and then the waters, after coursing in mad fury, are soon lost in the desert, being won again with infinite labour back to the fields by means of subterranean canals called *Kanat* in south-east Persia, and *Karez* in Afghanistan and Baluchistan. These canals run from distances of 10, 20, 30, and even 40 miles down into the valley.

The villages as a rule are small, and occur at considerable distances, and even the important cities like Kerman, the provincial capital, are not particularly prosperous. Yezd has lost much of the camping trade that made it rich, while the trade of Shiraz does not increase.

The People.

The Persian peasantry and the nomad tribes, the latter, mostly of Turki, Kurdish, Baluch and Arab extraction, are people of good physique, but the town folk are not. The heart of the nation was broken centuries ago, and now owing to its brains and manhood being sapped by opium and unrestrained vice, the state of Persia is pitiable, notwithstanding the natural intelligence of the people. Almost every office in Persia from the highest to the lowest is farmed out for a year, generally speaking, in which period the farmer or contractor has to recoup himself two or threefold (there is no fixed taxation or limit to demands) for the expense he was put to in obtaining the post. Khans, peasants, and traders (especially the last) pay two tomans, where in ordinary circumstances but one is exacted, and if they demur, a short cut is found to their pockets through the soles of their feet.

Unless some drastic changes are made in the system of government, any considerable or speedy change in the condition of the people and consequently in the trade seems hopeless. Our chief chance lies in persuading Indian traders (British subjects) to settle in Persia, and this they will do if they know they have consular protection at hand.

The Persian differs widely from the native of India, who, whatever he may spend on occasions of mourning or rejoicing is, whether Hindu, Sikh, or Musalman, a man of few wants and frugal to a degree. The Persian is not a man of frugal mind. He resembles the European and especially the Englishman in his preference for putting the money he earns on his back or into the stomach, and rejoices in good food and good clothes. The humblest Persian dresses and eats well; few men in rags are to be seen except among the poorest peasants and the professional beggars. He has a craving for the luxurious and showy, and though he himself dresses in sober colours, and his women-folk in the streets resemble sheeted ghosts, for the peculiar indoor dresses of the latter and for the adornment of his house he rejoices in gay prints and cretonnes, bright hued silks and rich satins. Like the native of India, he revels in looking-glasses, lamps, coloured-glass pendants, bright china, clocks, watches, knives, and European gimcracks. The floors of his house are, as a rule, carpeted with exquisite gems from the loom, which give evidence of considerable taste. He is a great drinker of tea, which he makes and drinks after the Russian manner, and his consumption of sugar, which he procures from France, Russia, Austria, and Egypt, is enormous.

The constantly increasing consumption of opium which is smoked as well as eaten induces a considerable increase in the demand for tea. It is a fact that opium has a far worse and more rapid effect on the Persian than on the Osmanli, the Indian, or the Chinaman. This is doubtless due mainly to the very impure nature of the drug, which is home manufactured and much adulterated. The opium habit is generally contracted in the season of fasting, when it is taken as a medicine. Once begun the Persian can never give it up; he goes from bad to worse, becomes a wreck in two or three years and generally dies in five or six years. Nevertheless, under a better system of provincial Government, the Persian might be given a fair chance in his own country and improvement in trade with India result. At present his knowledge of India is confined to one word, Bombay, while in default of familiarity with Indian products, money is squandered on silver horse trappings and other finery.

Among hindrances to trade may be mentioned the lack of bonded warehouses, and proper communication (road, postal, and telegraphic) as well as the safety of goods in transit. The balance of trade again is unduly heavy against Persia. The exports from South Eastern Persia into India, for instance, are too small to set off against imports from India into Persia. Unable to pay for imports by the sale of exports, Persian importers have to do most of their business in cash,

and their transactions being thus limited, they feel seriously the effects of the least disturbance in exchange. At the same time Indian traders fail to get the benefit of the appreciation of the rupee, for they cannot save in bank commission on the return of funds, neither can they profit by extensive purchases of Persian products in a cheapened market. Another reason is the apathy and ignorance of Persia and of its requirements prevailing among Indian traders.

Mr. Gleadowe-Newcomen here remarks that considering the exactions of provincial rulers, the indolent conservativeness of Mohammedan traders, the state of Persian commercial law (as regards the creditor especially) and the new Customs tariff, which doubles the price of a necessity like tea, not to mention the unjust clauses of the Règlement, he is surprised that matters, commercially speaking, are not worse than they are.

A great advantage possessed by the Russian manufacturers is that they cater for the wants of a population whose wants resemble those of a great part of the Russians themselves. The Indian producer must, therefore, study what the Persians want and set himself to supply exactly these requirements. Advantage, too, might be taken of the presence in India of certain Persian youths oi good family, who are being educated there, to be taken on tour in the winter months and shown everything in the manufacturing centres.

INDUSTRIAL ART EDUCATION IN FRANCE.

The principal industrial art schools in France, where the future artisans who are to continue the high traditions of artistic manufacture are educated and prepared for their work, are the following:—The Germain Pilon School. This is situated in a quarter mainly inhabited by small manufacturers and their workmen, and receives only day pupils. The normal age of admission is fourteen years, but boys of exceptional ability may be admitted when a year younger, provided they have obtained a "certificate of elementary studies" at a communal school. There is no formal entrance examination, but the candidate is required to execute a geometrical drawing to demonstrate his artistic aptitude, and write a short composition to show his degree of knowledge and general intelligence. The course of instruction lasts three years, and is thus divided:—First year—geometry, decoration, architecture, water colour, sepia, and black and white drawing, and modelling. Second year—perspective, anatomy, and geometrical drawing in sepia, ornamental designs for braids and trimmings, designs for furniture, the history of modern art, modelling and moulding. Third year—the same as the second, with the addition of decorative composition and study of standard styles of art. Students on leaving this school generally enter the workshops of some of the great furniture makers and decorators of Paris and the provinces, where, according to the American Consul-General at Paris, they earn at first about £4 per month, but they are always in demand and their promotion is certain and rapid.

The Bernard Palissy School, named after the great ceramic artist of the sixteenth century, may be considered a branch of the Germain Pilon School, above described, and is specially intended for the education of young men for certain industries, the designing and decoration of porcelain, designing of textile fabrics, carving and sculpture in wood, metals and stone. Only pupils of French nationality are admitted. The candidate must be fully thirteen years of age, and must reside in the Department of the Seine, and must pass an entrance examination in reading, writing, history and drawing. The course includes four years, during the first of which the pupils continue the ordinary studies, such as grammar, geography, arithmetic and history, as well as modelling, drawing flowers, lineal drawing and ornamental designing. They are taken in classes to visit various workshops and studios, where they watch the finished artisans at their work and choose each for himself what branch of industrial art he will follow. In addition to the practical work in each division, the study of the three final years comprises decorative composition, drawing from plaster casts, the human figure, modelling, perspective, the theory and history of art, and analysis of styles. There are at present in this school thirteen masters and one hundred and thirty-two pupils, divided as to choice of profession as follows:—Twenty-five decorators, twenty designers of textile fabrics, twenty sculptors in wood, ivory, and stone, sixteen porcelain painters, and fifty-one pupils in the first year who have not decided upon their special line of study. From this school come many of the leading decorative painters, textile designers, and artisan sculptors. The cost of maintaining these two schools is about £4,400 per annum, and they turn out altogether about sixty graduates each year.

Next in order, and a step lower in the scale of art industry, come two schools which are specially devoted to instruction in certain handicrafts pertaining to special industries. These are the Estienne School, in which are taught all the arts connected with the production of books, viz., artistic typography, binding, engraving on wood, metal and stone, photography and photogravure. The school was named after a celebrated family of printers, the first of whom, Henri Estienne, was born in 1470, and founded an important printing and publishing house about 1502, which remained at the head of the artistic publishing houses in Paris for upwards of 350 years. Applicants for admission to the "Ecole Estienne" must be of French nationality, not less than thirteen, or more than sixteen years of age, and resident in the city or suburbs of Paris. If the pupil lives in one of the suburbs (outside the fortifi-

HOME INDUSTRIES.

Cotton Supplies.—It looks as if the cotton crop of the present year will be equal to, if not larger, than the record crop, 1904-5. The returns of the Census Bureau giving the total amount of cotton ginned from the present crop up to the 15th inst., is 13,290,000 bales, in comparison with 10,697,000 bales last year, and 13,504,000 bales in 1904-5. At the same date the amount of cotton in sight was 11,590,000 bales, as against 9,086,000 last year, and 10,076,000 in 1904-5. But whilst the quantity exceeds the most sanguine estimates of the experts, the quality leaves much to be desired. The chief cloud in the sky just now is the growing friction between employers and employed, the demand of the hands for higher wages. But it may be hoped that an amicable settlement will be arranged.

Transport Charges and the Public.—Signs are not wanting that the time is near when the public will have to pay more for their transport over London. Whatever the cause, there can be no doubt whatever that the companies engaged in the transport of the public are doing badly. It is not that the public travel less than they did—there was never a time when so many passengers were carried—it is that carriage under present conditions does not pay. "All companies engaged in carrying passengers in London were," said the chairman of the District Railway Company at its recent general meeting, "if not losing money apparently making no profit." The Metropolitan and Metropolitan District Railways, now electrically equipped at a cost of over £3,000,000, are doing badly. The one has had to reduce its dividend for the six months ended December last from 2¼ per cent. to ½ per cent., and the other has a large deficit to face in its interest charges, having worked at a serious loss throughout the year. The Tube lines are making only small profits where they are making any. The Central London, particularly well placed, and with no expensive junctions, &c. to work, only pays four per cent. to its shareholders, and the City and South London just half that rate, whilst the Baker-street and Waterloo has failed to earn its full debenture charges, the Great Northern and City is a long way from making the profit required to pay a fair return upon its capital, and the Piccadilly and Brompton promises badly. Nor is the position of the omnibus companies more promising. One of the great horse companies has passed its dividend, and the other paid a reduced dividend which some shareholders consider ought not to have been distributed. It is claimed for the Municipal Tramways Systems that they pay well, but without fuller information than is available to the public, the actual position is doubtful, whilst the outlook for the motor omnibus is anything but promising, and experts affirm with confidence that if proper allowance were made for depreciation, it would be shown that not one of the lines, or at most only one of them, is being run at a profit. The capital of the chief passenger carriers of the metropolitan area amounts to some £47,000,000, and, after meeting fixed charges, the surplus profit, if distributed equally, would give a return of ¾ per cent. per annum only on this immense capital.

Workmen's Trains and Railway Investments.—Of course the transitional period through which London's transport system is passing has something to do with the poor results enumerated above, but when due allowance is made for this, it seems difficult to avoid the conclusion that fares require readjustment. The average fare is 1½d., and it it only the companies which approximate to 2d. per passenger—the Central and City and South London—that hold out the promise of something like a fair return upon capital. It was expected that the electrification of the underground lines would enable them to be worked at a much less cost, and, assuming this, there was a reduction of fares which compelled a reduction on other electrical systems, but which already has had to be modified, there having been serious miscalculation as to cost. Then the workmen's trains are a heavy loss. On the District Railway, where the workmen's traffic constitutes about 30 per cent. of the total traffic carried, the average receipt per passenger from workmen's train traffic is given by the Chairman of the Company as 0·65, whilst the cost of conveyance per passenger is stated to be 1·22. This question of workmen's trains is unimportant in the case of a large trunk line railway where the loss upon the workmen's trains is a comparatively small matter, the proportion to the whole business done being insignificant, but it is very different with the small local lines like the Metropolitan and Metropolitan District. It may be gathered from recent speeches of the President of the Board of Trade that he is fully alive to the difficulties under which the Companies dealing with the Metropolitan passenger traffic have to work. Speaking on the Railway (Contracts) Bill he gave it as his opinion that nothing should be done to make railway investments so unremunerative that the Companies could not get money for the purposes of development. What is wanted, amongst other things, is the establishment of a Traffic Board as recommended by a Royal Commission, and more harmonious working amongst the interests concerned. The public cannot be in the long run gainers by fares that spell loss to the carriers.

The Port of London.—The London and India Docks Bill comes up for second reading in the House of Commons on April 16th, and there is some hope, although at present it would seem to rest on no very solid foundation, that the Government may consent to make it a Ministerial measure. The President of the Board of Trade has said that he cannot tackle the very thorny problem of the Port of London till the Session of 1908, when he will seek to create a Port Trust to take over the existing dock companies and reorganise the Port generally. But the London and

India Docks Bill is receiving much support, and conceivably it might be amended on lines that would commend very general support. It gives the Port an authority to levy the dues on imported goods which is imperative if the money necessary to extend the docks and improve the river is to be found without a municipal subsidy, which would mean municipal control, and it does away with the "free water" rights of barges, two vital changes both of which were approved and recommended by the Royal Commission of 1902. Whether or not the Government see their way to support the London and India Docks' Bill, amended in various ways—and perhaps it is too much to expect them to add a London Port Bill to the present long list of Government measures for the Session—it is earnestly to be hoped that they will deal with this matter next Session. It is admitted that much money must be spent on the river and docks if London is to maintain her pride of place among ports, and spent without much longer delay.

Private Wires and the Post Office.—On Wednesday of last week Mr. Justice Swinfen-Eady gave an important judgment in a matter of considerable moment to shareholders in the National Telephone Company. By the Act of 1881 the Post Office is entitled to a Royalty of 10 per cent. on the earnings of all wires excepting such as are "maintained or used solely for private use," and accordingly claimed the Royalty on all wires other than domestic or departmental telephones. On the other hand the National Telephone Company construe the clause to mean that all wires are private which do not touch the public exchange, and are available only for communications between two places, the contention of the Post Office being that no wire is private which is not confined to the interests of one firm, or one individual, and that wires running between two places of business do not come within the meaning of the words "maintained or used solely for private use." Mr. Justice Swinfen-Eady agrees with the Post Office on the ground that "if the words 'private use' merely meant not open to be used by the public, then any number of persons might be connected by a so-called private wire, and apparently by a private exchange, so long as none of the telephones were open to use by the public." The decision is so important as affecting the purchase of the company's assets in 1911, that it may be taken that the case will ultimately go to the Lords.

Consols and Trade.—The present low price of Consols has induced much loose comment. It is said, for example, that the national credit, as shown by the quotation, is lower than for many years past, and that it has fallen more relatively than that of other countries. Neither contention will bear examination. The only true criterion by which the comparative value of a security may be tested, is net yield, and the only way of ascertaining how British credit stands as compared with other nations, is to make the comparison upon the identical rate of interest. What then are the facts, taking the last twenty years? Assume that at the end of March, 1887, the reader had £100 in Consols, and that throughout the period under review the stock was upon a $2\frac{1}{2}$ per cent. basis in all the countries with which the comparison is made. The yield to him at the outset, that is to say in March, 1887, was £2 19s. 6d., in March, 1897, it was £2 5s. 3d., in March of the present year, £2 18s. 9d. In 1887, the year before the Goschen conversion, Consols were quoted—if allowance is made for the rate of interest—lower than now, the comparison being 84, with 85 3-16ths. Nor is it more correct to say that relatively, as compared with foreign Government securities, Consols are alarmingly low. On the contrary, Consols really give a smaller return than any Continental Government security. At the present quotation they yield £2 18s. 9d., and French Rentes come next with a yield of £3 3s. 8d., not a great difference, but still one on the right side. On the basis of a $2\frac{1}{2}$ per cent. security these Rentes would be quoted at $78\frac{1}{2}$ against the $85\frac{3}{16}$ of Consols. German Consols are third, giving a yield of £3 13s. 2d., and an equivalent quotation of $68\frac{1}{4}$; then Italian, £3 19s. 3d., the same yield as Russian bonds, the relative quotation of both being $63\frac{1}{8}$; Hungarian Gold Rente, again, would yield £4 6s., the equivalent quotation being $58\frac{1}{8}$. As the Chancellor of the Exchequer has reminded the House of Commons the price of Consols in 1885 was $94\frac{3}{8}$, or the equivalent to $78\frac{5}{8}$ for a $2\frac{1}{2}$ per cent. stock, and, as he also pointed out, "many of the causes contributing to the decline not only of British Government stocks, but also of most other high-class securities, which has taken place during the last ten years are international in their operation, and are independent of Government control." Foremost amongst them is the increased demand for money, and, as was pointed out in the Notes last week, this is lagely due to exceptional industrial and commercial activity at home and abroad. But this is not to say that the abnormal expenditure of recent years, a total addition to the National debt in a few years of roughly £200,000,000 sterling, has had nothing, or has not had much to do with the fall in Consols. The comparison with other countries is largely what it is because they too, in more less degree, have been spending largely above the average of earlier years.

CORRESPONDENCE.

FAMINE IN INDIA.

Sir Frederic S. P. Lely writes:—

I ask permission to make a short rejoinder to Sir W. Wedderburn's note on my famine paper. It was not, in Gujerat at least, "a great central fact that the famines were not famines of food, but of poverty." To a great extent they *were* famines of congenial food.

As pointed out in an unread portion of my paper (pp. 419-20), large numbers of those who broke down did so from being put on a new and less nutritious diet, and from nervous collapse. Very many died who could buy plenty of food without going on relief works, but that food was only Burma rice. Then, again, the "reserves" of the people consisted mainly of (1) cattle, (2) loans to neighbours, and (3) ornaments, only the last of which is liquid in time of famine. The other two only add to a man's burden. Sir W. Wedderburn's suggestion is, in effect, that the ryot should be encouraged not to invest his money in productive agricultural stock or in helping his neighbour, but in hoards of cash or grain. This would surely not be an economic advance. As for credit, nothing that Government could do would have induced any sane man, as a matter of business, to advance money to the crowds of day labourers, and the comparative few small cultivators who flocked for relief. As a matter of fact, the people showed wonderful resource and self-support. It is true that one-fourth of them were getting relief in July-August, 1900, but that was at the time of the highest strain, when things were at their worst, and when also we are said by the Commission to have been over-liberal. Throughout the year the number was very much less—probably never much over 15 per cent. I doubt if the proportion in Lancashire after every mill had been closed for a year, would be much less. The townspeople do not invest their surplus in the same way as the country people, and it is very remarkable that after two years of famine the octroi revenue, in Ahmedabad city, upon many luxuries, showed no diminution. In other parts of India, the local Governments have often congratulated themselves on the increasing staying power of the masses. These facts are known to all who have really studied the subject in the villages. Of course, much may still be done to strengthen the ryot against his day of trial, but the subject is too large to discuss in a casual note.

OBITUARY.

MARCELLIN BERTHELOT.—The sudden death of Monsieur Berthelot on the 18th inst., immediately after the death of his wife, has deprived the world of a great scientific genius, and the Society of Arts of one of the most eminent of its corresponding members.

A Bill was passed in Parliament for a public funeral at the expense of the State. The funeral of M. and Madame Berthelot took place at the Pantheon, on Monday, 25th inst., in the presence of the President of the Republic, and a vast multitude, consisting of the most eminent men of France.

Marcellin Pierre Eugene Berthelot, the distinguished chemist, philosopher, writer and statesman, was born in Paris, October 29, 1827. In 1851 his life-long friendship with Renan commenced. In 1854 he at once became famous in consequence of his doctoral thesis on the combination of glycerine with acids. The results of his researches in synthetic chemistry were published in 1860. In 1859 he had been chosen Professor of Organic Chemistry at the Ecole de Pharmacie, Paris, and six years later a Chair of Organic Chemistry was created for him at the Collège de France, which he occupied for the rest of his life. Here he devoted himself to the study of the relation between heat and chemical change, and his researches were described in his "Méchanique Chimique fondée sur la Thermo-Chimie," published in 1879; and followed in 1897 by two more volumes on Thermo-Chemistry. Besides these great works, M. Berthelot was a voluminous writer of papers, commencing in 1850, as may be seen from the Royal Society catalogue of scientific papers.

Mons. Berthelot was Minister of Public Instruction in the Goblet Cabinet in 1886-7, and Minister of Foreign Affairs in the Bourgeois Cabinet in 1895-6. From 1876 he was Inspector-General of Higher Education, a Life Senator in 1881, and in 1889 he succeeded Pasteur as Perpetual Secretary of the Academy of Sciences.

GENERAL NOTES.

THE PHILIPPINE ISLANDS.—Most of the foreign carrying trade of the Philippines remains in the hands of British shipping. The proportion to the whole has indeed fallen off, American and Spanish ships being the gainers, but of cargoes valued in the aggregate at £12,938,922, the British share was £8,775,465, as shown in the latest Consular report (Cd. 2682). It may be noted in this connection that the Act of Congress passed in April 1904, extending the United States coasting laws to these islands, known as the Frye Shipping Bill, has been postponed until 1909. One of the most striking features of Philippine trade for the year under review was the increasing trade with Australia, which country is now a formidable competitor of the United States in the market of raw materials. This result Mr. Consul-General Kenny attributes in no small measure to the energy of the commercial agents of the various Colonies who periodically visit the islands, and the enterprise of colonial exporters in sending representatives to the Philippines to bring their produce to the notice of the local buyers. The statistics of the flour trade furnish a good example of this. In 1903 the value of the flour imported from the United States was £161,302, in 1905 it had fallen to £104,573. On the other hand the flour imports from Australasia, taking the same period, rose from £237 to £48,404.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, APRIL 10, 8 p.m. (Ordinary Meeting.) LOUIS FELBERMAN, "Arts and Industries in Hungary, in Ancient and Modern Days."

Further details of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday evening, March 19; SIR LUKE FILDES, R.A., in the chair.

The paper read was—

OILS, VARNISHES, AND MEDIUMS USED IN THE PAINTING OF PICTURES.

BY A. P. LAURIE, M.A., D.SC.

(Principal of the Heriot-Watt College, Edinburgh.)

While in the past various mixtures were used by artists for painting, some of which are only obscurely understood, the necessary mediums for modern painting are, comparatively few.

The old painting in beeswax, which has proved remarkably durable, is no longer practised, and tempera painting with an egg medium is only used now and then. There are in this connection certain unsolved problems, such as the real nature of the medium used by Van Eyck and his immediate successors, which are of historical interest, but which I do not propose to discuss here. The medium in which the pigments are mixed must be closely related to the technique adopted by the painters of the day, and it is not at all probable that the medium used by Van Eyck, while united to his technique, would be of the slightest practical use to the modern painter. An artist's medium, then, has to serve more than one purpose. It must attach the pigment to the paper or canvas on which the picture is painted; it must facilitate the use of the pigment by the artist, and it must bring out all the qualities of translucency, and so on, which the pigment possesses. It should also, as far as possible, protect the pigment from change and injury, either mechanical or chemical. The simplest example of such a medium is the mixture of gum arabic and water, used in water-colour paintings. The gum arabic serves to attach the pigments to the paper, while the water gives the necessary facility to the pigment under the brush, and the qualities of the pigment are developed by thicker or thinner washes on the white paper background. Such a medium, however, does nothing to protect the pigments used from change, and has a limited though beautiful range of expression.

Painting in oil is practically the only other method used by the present day artist, and it is to painting in oil that this discussion will be devoted.

In selecting an oil as suitable for artists' purposes it is necessary to choose what is known as a "drying oil." If, for instance, pigments are ground in olive oil the surface would never dry and it is, therefore, useless for the purpose. There are certain vegetable oils which have this property of drying and which are, therefore, suitable for artists' purposes. I shall only refer to three here, linseed oil, poppy oil, and walnut oil. There is no need to trouble you with the chemical composition of these drying oils, but it is important that the nature of this drying process should be clearly understood. These oils do not dry in the ordinary sense of the term at all. They undergo a process of oxidation when exposed to the air, which converts them from a liquid condition

into a tough elastic solid, a solid which slowly undergoes further oxidation, becoming brittle, hard and resinous. It is then to this process of oxidation that their peculiar properties are due.

These oils are obtained from the seeds or nuts, and are present in those bodies as part of the reservoir of food supply for the young embryo of the future plant.

The oil from linseed is obtained by crushing, grinding and pressure, and in order to increase the yield the ground mass is heated as well as pressed, thus obtaining what is known as a hot pressed oil, which is subjected to various processes of refining and bleaching. Personally, while regarding such an oil as quite suitable for house painting, I doubt very much the wisdom of using it for artists' purposes. The hot pressing results in the presence of many impurities which are removed by the addition of sulphuric acid. The chemistry of the whole subject of painters' vehicles is so obscure that it is as well to cling to tradition where possible.

The linseed oil of the earlier centuries was cold pressed linseed, and was refined and bleached by the simple process of exposure to air and sunlight over water. These methods yield a beautiful oil, and should be adhered to for artists' purposes.

Poppy oil is obtained from the seeds of the opium poppy (*Papaver somniferum*) by crushing and pressing, or by other means of extraction, and is easily bleached. It is often used for grinding with whites or delicate blues. It dries more slowly than linseed oil, but has the advantage of being almost colourless.

Walnut oil is obtained from the common walnut (*Juglans regia*) by allowing the nuts to decompose partially and then pressing, and can be obtained almost colourless. It was largely used by the early Italian painters as a drying oil. There are other drying oils, but they are not of special interest to artists.

Having briefly discussed the three drying oils commonly used for artists' purposes, we now go on to consider some of the other vehicles and mediums. The pigment having been ground stiffly in oil is supplied to the artist, who may thus dilute or mix it further, and we shall proceed to consider the materials he may use.

In the first place he may merely add a little more of one of the oils already referred to. In case, however, that he wishes his picture to dry faster, he may use as a medium instead of raw oil, boiled or drying oil.

The property of the boiled oils depends upon the fact, that if, for instance, linseed oil is heated for some time with certain compounds, more usually either compounds of lead, such as lead oxides or lead acetates, or compounds of manganese such as manganese borate or resinate, it becomes partially oxidised, and if painted out on a surface will "dry" much more quickly.

Of the two methods of preparing drying oils described above, the use of manganese is I think preferable, and for this reason. A certain amount of the substances used dissolves in the oil, and consequently an oil prepared with lead dryers contains lead in solution, and is very easily darkened by impure air containing sulphur compounds such as sulphuretted hydrogen. It is, therefore, probably better to keep such oils out of modern pictures which are exposed to the impure air of cities.

Besides diluting with oil, the artist may prefer to dilute with a medium, which will evaporate and leave the layer of oil originally present behind. The mediums most commonly used for this purpose are either turpentine or petroleum. Turpentine, which is obtained by distilling the natural gums of the various pines, is a very suitable medium, as it not only evaporates easily, but also assists in the oxidation of the oil. It has been objected to turpentine that it does not evaporate clean, but always leaves a slight resinous residue behind. This is quite true, but the amount of this residue is very small, and, as far as my experience goes, it gets fairly hard in time, so that there is probably no objection to its use on this ground.

The petroleum oils have the advantage when properly rectified of evaporating quite clean and leaving no residue. I have said, when properly rectified. It is important before using such a medium to moisten a piece of blotting paper with it and expose it to the air for a short time. If properly rectified the petroleum evaporates completely, leaving no greasy stain behind.

Artists sometimes forget the real property of these mediums, and then complain afterwards that the pigment does not adhere properly to the surface of the picture. The amount of oil used for grinding different pigments varies very considerably. If the ground is slightly absorbent, and the pigment stiffly ground and diluted by the artist with petroleum, the oil in the pigment dissolves in the petroleum and passes freely into the absorbent ground, leaving the pigment when the petroleum has evapo-

rated without sufficient oil to bind it to the canvas. This may happen with one pigment but not with another, if in the original grinding more oil has been necessary to get a good consistency.

Having now dealt with the more important diluting mediums, we will consider next the question of varnishes. A very large variety of gums or resins are now available for varnish making, but the number used for artists' purposes is not great.

Varnishes may be conveniently grouped into two divisions, the one called spirit varnishes, and the other oil varnishes; the spirit varnishes are prepared from the softer and more soluble gums by dissolving them in some medium which will evaporate and leave a layer of pure resin behind, such as turpentine, alcohol, or petroleum. The varnish artists are most familiar with is prepared by dissolving gum mastic in turpentine. By evaporating, a layer of mastic is left behind. Shellac is usually dissolved in alcohol; and there are also petroleum varnishes in use.

Such spirit varnishes are brittle, weak, and easily dissolved or removed. They should, therefore, form no part of the body of a picture, but may be used to varnish a completed picture when thoroughly hard, mostly as a protective transparent coating which can be easily removed without injuring the painting beneath. Mastic varnish, for instance, can be removed by lightly rubbing with the tips of the fingers, the powder of the resin largely assisting. They are apt to bloom, in which case the bloom can be removed by a damp cloth, and some hold that they tend to crack the picture beneath; I have found no proof of this however.

We next come to the oil varnishes. Oil varnishes are or should be made of the harder gums which will not dissolve freely in turpentine or alcohol. To make an oil varnish the gum is fused and the hot oil added, and the whole heated until a drop placed to cool in a glass plate cools clear. It is then diluted with turps. To prevent too slow drying a drying oil may be used, or driers added, and heated with the varnish. While thus the fundamental process is simple, in practice great technical skill is required. But again, either manganese or lead driers can be used, and I advise, for artists' use, manganese driers; although the varnishes so prepared do not in my experience dry so quickly. The number of gums available, their means of supply, names, and properties, form a large and confusing subject, especially as no fixed and clear nomenclature has been arrived at.

For artists' purposes, a hard gum should be utilised, such as Zanzibar or Sierra Leone copal, or the hard kauri gum from New Zealand. Carefully selected pieces, light in colour, should then be carefully fused, and incorporated with pure linseed oil. Amber is a very hard gum of high melting point. The main trouble in using it is the difficulty of preventing it from getting too dark on fusing. This can be overcome, but in so far as I have been able to test its properties, it has no advantage over the kauri resins or copals. These, then, are the principal mediums in everyday use for painting oil pictures. I have excluded all special fancy mediums, as I do not know their composition. They may be quite harmless, but I object to them as a doctor objects to a patent medicine. An artist, if he is wise, will only use such mediums as are of known composition, and have stood the test of time and experience.

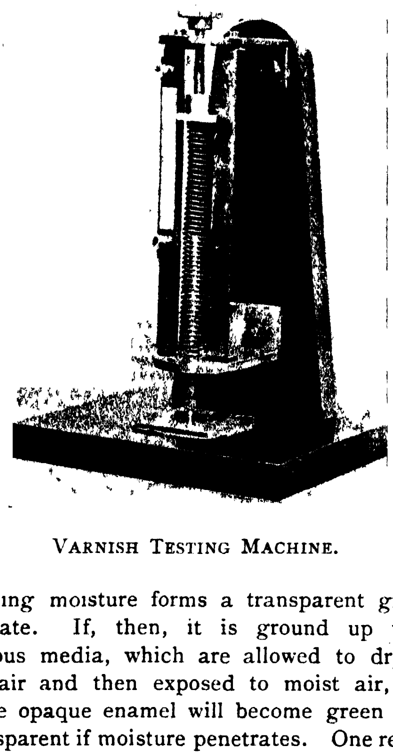
We shall next, then, proceed to consider various problems which arise in connection with these mediums, and which, I may frankly say, are far from being solved.

In the first place then how far do pigments act chemically on each other when mixed in an oil vehicle. To take a typical example. Will a mixture of white lead, which is so sensitive to sulphur compounds, turn black when mixed with vermilion (sulphide of mercury) or with cadmium yellow (sulphide of cadmium)? It is sometimes stated in the text-books that these pigments must not be mixed together, but all practical experience is against this view, and when we examine a pigment ground in oil under the microscope, and notice how the particles are each protected by a layer of oil, it is difficult to see how, unless the pigment is soluble in the oil, any action can take place. There is one well-known case when such action does take place, the turning brown of a green made with emerald green and cadmium yellow, but this I take it is due to emerald green dissolving slightly in the linseed oil. I once made an experiment which I think is of interest in this connection. I rubbed out some cadmium yellow ground in oil on a glass plate, allowed it to dry, and then coated it with a layer of linseed oil, allowed this to dry and then coated this with emerald green in oil. At the end of six months the combination had turned brown and a section under the microscope revealed the fact that the top layer of cadmium yellow had turned black. This must have been due to the

solution of the copper in the emerald green in the linseed oil and the slow diffusion of the copper salt molecules through the solid oil, with formation of black copper sulphide. It is evident then that pigments soluble in linseed oil will slowly diffuse through the solid oil and attack other pigments, but if they are insoluble no change seems to take place.

The next question is how far does the oil protect pigments from external influences, air, moisture, and injurious gases. I read many years ago a paper dealing with this subject at the Society of Arts.* Ignited sulphate of copper is a white opaque powder which is intensely hygroscopic, and in attracting moisture forms a transparent green hydrate. If, then, it is ground up with various media, which are allowed to dry in dry air and then exposed to moist air, the white opaque enamel will become green and transparent if moisture penetrates. One result was to show that while pure resins dissolved in turps formed moisture-tight surfaces, oils and oil varnishes were all quickly permeable.

FIG. 1.



VARNISH TESTING MACHINE.

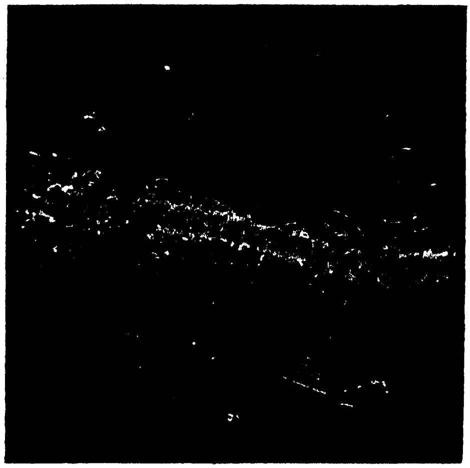
The same is true of other gases. Sulphuretted hydrogen quickly blackens white lead in oil through even an oil varnish, but if the white is ground in Canada Balsam and then varnished with Canada Balsam, the white is protected. Verdigris forms a permanent green in such a medium. It does not, however, stop though it checks the fading of crimson lake, showing that there is probably some decomposition of this colour in sunlight apart from air and moisture.

* *Journal*, vol. xxxix., 1891, p. 392.

It is evident, then, that while a freer range can be allowed to the oil colour than to the water colour palette, it is safer to select pigments which are permanent in themselves and not to trust to their protection by the oil from change.

The next question to be considered is the durability of the oil and varnish surfaces themselves. This has not received very much investigation as far as I am aware. I have been recently making experiments with a view to getting some comparative test for the combined toughness and hardness of a varnish. The method is to place the varnish painted out on a glass plate, and dry, under a blunt steel point, the pressure of which on the varnish can be increased by known amounts with a spiral spring.

FIG. 2.



MICROPHOTOGRAPH OF SCRATCH THROUGH CHEAP RESINOUS VARNISH, SHOWING CONCHOIDAL FRACTURE.

The varnish is then drawn under the point, and the pressure is increased until the varnish shows a clear definite scratch. Under this test the brittle spirit varnishes break down at a pressure of 100 grams on a steel point of 1 mm. radius, oil varnishes made from soft gums at from 300 to 500 grams, and oil varnishes made from hard gums, at from 900 to 1,200 grams. Moreover, the character of the scratch is very different. Varnishes with an excess of resin in them, and therefore made from soft, easily dissolved gums, give a

splintery scratch, while the tough oil varnishes, made from hard gums, give a tear. On exposure to weather during winter the varnishes are all soon reduced to a brittle surface which scratches at 100 grams, in summer however, they are improved by exposure. This clearly indicates that frost has probably much to do with this, and it is worthy of further investigation. It is easy by this machine to pick out a good varnish for the artist to use as a medium; and if this is done, no doubt the life of the picture, if kept under proper conditions, will be very much increased.

The next question to be considered is the occasional and capricious cracking of pictures. The explanation of this has, I confess, so far completely baffled me, but there are certain matters of interest in connection with it worth mentioning.

The great difficulty I have found in investigating this matter is due to the fact that I have been unable, under any condition, to produce cracking. The first experiment I tried was more than twelve years ago, when I painted out two, three, and four coats following each other quickly as soon as the last coat was sufficiently dry on the surface, of flake white (1) ground stiff with oil; (2) diluted with more oil; (3) diluted with copal varnish and (4) diluted with petroleum.

The same set of experiments were repeated with lead sulphate and zinc oxide paint, and with pure zinc oxide, thus making in all 48 different panels representing the different conditions. They are all perfect and show no signs of disintegration to-day. I have also tried painting on ordinary primed canvas with yellow ochre, and then as soon as it was sufficiently dry, laying over it strips of umber, a quick drying pigment—result, no cracks.

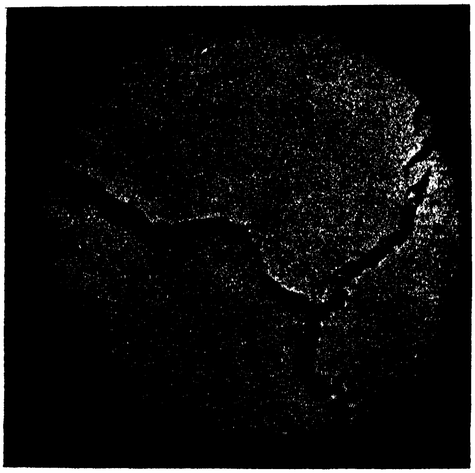
I have also tried the following combinations, undermost oil paint + mastic or pure mastic, second coat oil paint, third coat oil paint + mastic, umber + mastic, then yellow ochre, then mastic varnish, oil paint + olive oil, umber in oil on top, mastic on top, shellac varnish on top, and other similar combinations. All were hurried, no proper time for drying was allowed, and after twelve months they were free from cracks.

In no instance did any crack, with the exception of the shellac varnish, on the paint mixed with olive oil. I noticed, however, one curious result, the yellow ochre on the top of mastic varnish cracked while still wet owing to surface tension effects, but changed no more after it was dry.

These experiments then were all negative in their results, and certainly eliminate many of the causes to which cracking is supposed to be due.

I had the good fortune to be presented with two pictures which had cracked badly within a few months of painting. In the first picture mastic had been used as a medium, and the cracking was confined to the parts where thin liquid painting had been done and mastic probably freely used, as the surface here was hard and brittle. The canvas was of very poor quality, hardly closer in mesh than coarse muslin. A section through a crack when placed under the micro-

Fig. 3.



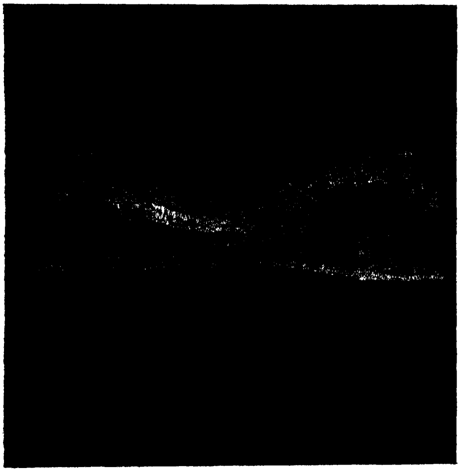
Microphotograph of Crack in Picture, Showing Cracked Upper Layer (Dark), and Uninjured Lower Layer (Light).

scope showed the crack to be merely through the upper painting, and to be a broad crack with straight edges perpendicular to the painting surface. The priming had not cracked, but seemed to be drawn out under the crack.

The second picture was painted on a closely-woven canvas which had been lightly sized and thinly primed by the artist with a mixture of pigments and linseed oil. The cracking was confined to the white masses of hard dry paint in the sky. A section showed that these cracks also formed broad cracks with perpendicular edges without injury to the under-coating of paint. The undercoating of paint did not, however, seem to be properly attached to the canvas, a layer of spongy disintegrated material apparently having formed in some way. This condition of things prevailed all

over the canvas and suggested that, owing to some disintegration between the canvas and the lower coats of paint, the coats of paint had been stretched, resulting in cracking of the upper coat where it was not elastic enough to yield. In order to get some light on the possible causes of cracking, I determined to measure the actual movements taking place in the canvas itself under different conditions. For this purpose I attached a strip of sized canvas by one end to a glass cylinder and weighted the other end so as to keep it taut over the cylinder. A platinum wire was firmly sewn to the canvas across and projecting out each side, and two little glass rods attached to the glass as indicators. The length of the canvas from the attached end to the platinum wire was 2 centimetres. By measuring the distance between the glass rod and the platinum wire it was possible to measure any expansions or contractions of the canvas itself.

FIG. 4.



MICROPHOTOGRAPH OF SECTION THROUGH CRACKED PICTURE, SHOWING CRACK THROUGH UPPER LAYER, AND UNINJURED LOWER LAYER OF PAINT.

By measuring at both ends and taking a mean any twisting of the canvas was eliminated. On first measuring, the average distance between the glass rod and the platinum wire was ·45 of a millimetre. The cylinder was then enclosed for twenty hours over strong sulphuric acid so as to dry the canvas thoroughly. The distance had now increased to ·55 mm., showing a contraction of the canvas on drying. It was now kept fo twenty hours in an atmosphere saturated with water vapour.

At the end of this time the readings showed a distance of ·28 mm., showing a total expansion from dry to moist air conditions of ·27 mm. On again replacing over strong sulphuric acid the distance increased to ·57 of a mm., showing a change in length of ·29 mm., or, taking the mean, of ·28 mm.

The canvas was now painted thickly with yellow ochre, and put back in the sulphuric acid and allowed to dry. After one day the distance between the points was ·54 mm., and after thirteen days when paint fairly dry it was ·577 mm., showing very slight changes in length during the drying of the paint. After twenty days the distance between points was

FIG. 5.

APPARATUS FOR MEASURING EXPANSION AND CONTRACTION OF CANVAS.

·57 mm. On now putting into saturated water vapour, the distance between the points became ·36 mm. instead of ·28 mm., showing a distinct and definite contraction on the original canvas.

A coat of umber was now laid on the ochre and allowed to dry in saturated air. In three days the umber was dry, and the distance between points was ·34 mm. On now putting back in dry air a further slight contraction took place, the distance between the points becoming ·66 mm.

A coat of yellow ochre was now put on and left over sulphuric acid; at the end of seven days the reading was ·73 mm., and at the end of a fortnight ·72.

These figures are a little difficult to follow, but leaving out small fluctuations they bring out the following facts very clearly.

In the first place, the total expansion, from dry to moist air, of the canvas tested, was ·28 mm. for 2 cent. length, or for 1 cent.—that

is 10 mm.—it was 1·4 per cent. In the second place, the drying of the thin layers of paint produced a total contraction of the canvas amounting to about ·16 mm. This contraction did not necessarily show itself while the paint was drying under fixed atmospheric conditions, but as soon as the canvas was set moving by change in atmospheric conditions, it asserted itself.

It is of interest to compare the magnitude of these movements with those required to produce a badly cracked picture.

The cracks in the picture mentioned above, varied in diameter from ·12 mm. to ·3 mm. roughly averaging ·2 mm., and measurements in different directions showed an average of about twelve cracks to 10 centimetres = ·24 mm. per centimetre, or about double the total expansion of the canvas, as tested.

After nine months, the strip of canvas painted as above described, was alternately put over sulphuric acid and over water some two or three times, expanding and contracting freely, but without cracking the paint. Another possible source of mischief had to be investigated and that was the freezing of a damp canvas. Two pictures were taken, one a canvas which had been primed twelve months before with sulphate of lead and zinc oxide, the other a portion of canvas previously described which had twelve monthe before been coated with yellow ochre and then when only just dry on the surface coated with umber. After 24 hours in saturated air they were kept some 4 or 5 hours in a freezing mixture. No cracks developed and sections showed all coats firmly adhering.

While, then, the result of the experiments has failed to reveal the cause of cracking, in the pictures examined, considerable negative evidence has been accumulated which should give us confidence in modern methods of painting. Cracking seems to be due to an expansion of the under layers (possibly due to the action of moisture and frost) which shows in cracks when the top coat is hard either from excess of pigment or from the presence of a medium like mastic.

On the other hand a sound canvas, properly sized and primed and painted with pure oil, and good oil varnishes, with the exclusion of fugitive pigments, seems to withstand very severe treatment without appreciable injury.

There is also very little evidence to confirm the usual statements about expanding surfaces when the paint is drying under normal conditions.

DISCUSSION.

The CHAIRMAN, in opening the discussion, thought all artists were under a deep obligation to the author, not only for the interesting paper he had given but for the thorough investigations he had carried out with regard to the properties of canvas, oils, and varnishes. After hearing the paper, he was very forcibly struck by the fact that there was a more hopeful outlook for artists in regard to the materials they used than he thought there would be before he attended the meeting. He had rather dreaded being present to hear the denunciations of the practices of artists, of which he was afraid many must admit they were guilty. He had imagined the author would state that the courses artists were now pursuing would end in the destruction of their efforts, but it was very comforting indeed to know that Dr. Laurie had tried his worst, and the quality of the work sseemed to be able to withstand even the very severe test he applied to it. It was very interesting indeed to notice the dissipation of certain traditions held by artists. For instance, with regard to cracking, he did not suppose there was any artist who was prepared to state what it was he had done which had caused the cracking of pictures. He had submitted some of his efforts to his friends, and they had without hesitation told him the reason of the cracking, and yet the author, with all his vast knowledge and experience admitted he did not know why pictures cracked. He thought the subject ought to be taken up by practical artists for the purpose of aiding investigators such as Dr. Laurie, so that artists would be able to perfect their methods. As it was, artists were extremely indebted to Dr Laurie for carrying out the work he had done on behalf of the profession. Artists were not particularly well up in the technicalities of chemistry, and he had no doubt Dr. Laurie would be able to elucidate any point which was not clear to any gentleman present. He thought it was obvious why the author had not referred to the firms which supplied artists with their materials. The present days were different from olden times, when the boy painter was apprenticed to his master, and learned the composition and use of different materials; but present day students did not seem to get very much information on the subject, not being taught by their masters the properties or the use of the materials. There was a good deal of "go as you please" among the professors and schools which he thought might well be corrected. He thought the master ought to explain to the student his method of painting, and what he should do and what avoid. There were broad principles which every student should know, and it would undoubtedly help him greatly to have a knowledge of his materials. He thought it was a well founded belief that the firms which provided artists with colours could be relied upon to produce the very best article, and they supplied what they stated they sold. As a rule that was the case in the very best firms. So that, taking it altogether, he felt more hopeful after hearing the paper than he did

before he came to the meeting. There was only one fear he had, namely, that if the author and other investigators succeeded in perfecting their processes, pictures painted in the future would not have cracks, and the colours would never change, so that modern painters would not be esteemed as old masters were, because many of the so-called merits of the old paintings appeared to depend a great deal upon the defects which the author had denounced.

Mr. ALFRED EAST, A.R.A., said he was somewhat disappointed at the paper, because he thought artists had not obtained much practical information from it, except a knowledge of the sources from which they could obtain their materials, which did not interest them very much. What artists desired to know was which materials, if used, would produce permanency when adapted to their use. The question of the cracking of pictures, however, did interest artists greatly; and in that connection he disagreed with Dr. Laurie's suggestion that the cracking was due to the canvas. It could not be due to the canvas, since pictures cracked when painted on wood panels. If the author asked one of his artist friends to take a number of new canvasses and paint out of doors, from early morning till sunset, he would find that none of them cracked; but if the artist took out old canvasses which had already been painted on and did the same thing, he would find those of the morning and evening would, after a short time, invariably crack, because the atmosphere would deposit a film of moisture upon the surface which prevented the adhesion of the second coat of paint upon the first. That was borne out by the habit of rubbing a potato on an old picture before it was re-painted, which invariably cracked in time. There must be a solvent upon the old paint which formed a tooth for it to grip in the contraction of drying. Artists had carried out such experiments for the past twenty years, and he thought they gave a clue to the real cause of cracking, which he believed was a fault entirely due to the artist and not the fault of the pigments or the vehicle. There was one other point to which he wished to refer, namely, that artists were in the hands of the people who prepared the pigments. The contrary was the case with regard to foods and drugs, because an Act of Parliament laid it down that the constituents must be known of any preparation sold under a particular name. That, unfortunately, did not apply to the composition of pigments. Another point was that artist's colourmen were in the habit of grinding all the pigments with the same oil, with the result that some dried fast and some slow. If a colour which dried slowly, such as madder, were ground with poppy oil, it stood to reason that if a fast drying colour was placed over it there must be underneath a contraction in the process of drying which would cause cracking. He particularly desired to hear the author's opinion on points of that kind. As a practical painter he thought it was desirable that painters should have a greater knowledge of chemistry, and that the chemists who dealt with vehicles and pigments should have a greater knowledge of painting. A combination of chemists and painters was required.

Professor J. M. THOMSON, F.R.S., stated that he had not attended the meeting for the purpose of discussing the paper, for the very good reason that the author had been asked to give the Society some information which he (Professor Thomson) could not give it in his paper on pigments last year. His duty in the previous year was to take the pigments and show the reactions which they had upon each other, but he was not, like the author, *au fait* with the question of varnishes and media. At the same time although he could not discuss the subject, he desired to point out to the meeting that Dr Laurie had opened up an enormous number of extremely interesting points for investigation. He was sorry that Mr. East had not been able to learn much about the practical application of the subject from the paper which had been given, but the question was in its very beginning. No one had ever examined the subject in the way Dr. Laurie had done; and he had rarely heard a difficult question containing as it did such a wide field so clearly and distinctly put before an audience. Although he could not criticise the paper, he congratulated the Society upon Dr. Laurie's paper, and his extremely brilliant and clear exposition.

Mr. WALTER F. REID cordially supported Professor Thomson's remarks as to the interesting nature of the experiments described by the author. He thought the micro-photographs, which had been shown, threw a good deal of light on the actual structure of the film of paint upon the canvas. Personally he did not think the canvas was at fault, not only because cracks were found on paintings executed on copper and wood, but also, as the author had stated, the cracks were found on one set of paintings and not upon others, although they were painted on similar canvas. He was rather disappointed that the author at the commencement of his paper dismissed, in such a very short manner, the old mediums that were used, and which had lasted for such a very long time. He was sorry beeswax was dismissed in such a curt manner, because he believed it was a medium which might be adapted. Artists now had absolutely permanent foundations, there being forms of asbestos in sheets which were completely mineralised, and which would give a better foundation than canvas, wood or copper. If modern artists would only utilise the materials which ancient artists used, and which it was known were durable, pictures would be painted which would last. Very clear descriptions existed of how the materials were prepared, written by Vitruvius, and other writers. Ordinary beeswax was not used, but what was called Punic wax, which was ordinary beeswax kneaded in sea water, exposed for a long time to the atmosphere, and purified by a special

process described. Another important point was that it had not the action on many pigments which linseed oil had. It was well known that linseed oil first became elastic and tough. He had made a number of experiments on the strength of the material, and had found that a film of it would stand its own weight in a length of about 10 feet. That was its tensile strength when it was new; in about a month's time it was halved, and it became rotten very quickly indeed. The author stated that, in his opinion, the elastic substance became ultimately converted into a resinous brittle substance. He desired to ask Dr. Laurie whether he had ever carried out experiments in that direction, because as a fact the reverse was the case. If the elastic tough substance which was the first product of the oxidation of linseed oil was exposed to the air under ordinary conditions in a room, a syrup was obtained. He showed at the Society in 1891, a sample of the very best quality of linseed oil which had been exposed to the air since 1878, and had liquified; he looked at it on the previous day and found that it was even more liquid than it was then. It kept on absorbing oxygen from the atmosphere. He had made an experiment on a thousand tons of linseed oil, and found that the oxidation forming the gelatinous or elastic substance caused an increase of weight of about 12 per cent. If such substances as bitumen, umber, especially burnt umber and some of the oxides of iron were used, cracking would undoubtedly be obtained in a year or two, especially if used on a foundation of linseed oil paint and not direct on to glass or some firm substance, because the linseed oil paint underneath softened; and when the super-oxidised oil in connection with bitumen became soft then the tendency was for the whole thing to crack up and contract. The contraction was enormous in the case of bitumen. He had a portrait at home painted by Sir Thomas Lawrence in which the cracks were nearly a quarter of an inch wide. Some of Lawrence's pictures in the National Gallery also showed great cracks in the dark colours, but they had been repaired and did not show up so well. Such facts he thought were incontrovertible; anyone could make the experiment and ascertain the results for himself; and he thought they threw considerable light on the real cause of cracking. He would not say that canvas was a desirable thing to paint on because it was perishable. He had seen canvas which contained a good deal of jute, which was one of the most perishable fibres, but that was due to the dealers. He thought the dealers were not quite so open with the wares that they sold to artists as they might be. The secresy observed by them had been handed down from the middle ages, but he was inclined to think that a colour manufacturer who would invite his clients to go into his factory and watch the processes would do a very good business indeed, and that his competitors would suffer. Many manufacturers pretended to have secrets which they really did not possess, because the foundation of the manufacture of pigments and varnishes was thoroughly well known. The method of purifying linseed oil with water was a very good one as far as it went, but it was a little fallacious, because no matter how long the oxidation went on a deposit was obtained at the bottom of the water, the reason being that the oxidised linseed oil which formed was heavier than water, consequently whenever unoxidised oil was exposed over water the oxidised oil fell down to the bottom of the water and a sediment was obtained. It was not an impurity in the oil at all, it was the oil itself. Such treatment did get out all the corruptible snbstances in the oil in the first instance, and that was an advantage. The material that Van Eyck used was, he thought, very well known, having been left on record. There were Italians who claimed that Antonelli di Messina invented painting with linseed oil, and in the Corsini library at Rome some interesting particulars were given about the materials used. Clearly linseed oil was referred to, but nut oil was mentioned earlier than linseed oil in the Italian record, and it was rather doubtful whether the nut oil was walnut oil. The question the author had raised with regard to manganese and lead was one of importance. It was quite true that lead darkened with sulphuretted hydrogen, but it must not be forgotten that manganese itself darkened through oxidation. Although the experiment the author showed was very striking, the proportion of manganese must be kept as low as possible in order that the oil might not discolour itself afterwards. He thought the author would acknowledge that the experiment he showed was made with a much larger proportion of lead than there would have been in oil boiled with lead. With regard to turpentine, unless it was analysed at the time it was bought it was impossible to know what was being sold. The whole trade was being disorganised, because certain manufacturers bought up all the turpentine that contained certain chemical substances for use in a new synthetical process. It was a most difficult matter to buy two lots of turpentine on the market of the same quality. Petroleum was very stable and useful, but the difficulty connected with it was that it was not such a good solvent as turpentine. He desired to express a word of admiration for the interesting little pieces of apparatus exhibited by Dr. Laurie, which were of very great use in investigations. He hoped the author would continue his researches, and read a further paper on some future occasion. The analysis by the author showed that the amber varnish could not have been a true sample, although probably it had been sold as such. He knew from many years' experience that a good amber varnish was the best in the world, the reason probably being that amber varnish contained the oldest fossil resin. At the St. Louis Exhibition there was a splendid exhibit of amber from Prussia. The Prussian Government had taken over the whole amber industry. They produced from the waste what they called amber colo-

phony, which they found was very much better for making varnish. He had seen some of the best varnishes made from that substance, which was easily soluble in oils. He desired also to refer to the question of movements in the canvas. He thought it would be found in any painting that had cracked that it colud not be due to any shrinking of the whole picture, because unless some buckling of the picture took place the surface remained the same. It could only be a relative movement of parts, and as that did not take place in an ordinary good picture it would hardly be the only reason for the cracking in an indifferent one. If only one firm of artists' colourmen would take artists more into their confidence, he believed the artists would flock to that particular firm and buy their materials there.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his intensely interesting and instructive paper, said from his own point of view as an artist, he was deeply indebted to Dr. Laurie for the way he had started the subject. He did not presume for a moment that the author meant his dictum should be taken without any question at all; he had merely brought the question forward in the experimental stage in order to try and discover the best means of correcting any defects that existed. He thought no greater compliment could be paid to the author than the remarks that Mr. East had made. Mr. Laurie's address was not intended to be final; it was intended to provoke discussion, so that the ideal Mr. East desired might come about, namely, to get a combination of the artist and the chemist. He agreed with Mr. Reid's expression of admiration of the experiments made by Dr. Laurie, and particularly with regard to the instruments he had designed, which he thought were admirably conceived for the object he had in view. It was extremely difficult in such matters to put forward any proof of a particular assertion, and an artist wanted a great deal of proof before he accepted any particular statement. He had been quite charmed with the micro-photographs, which demonstrated the truth of the assertions Dr. Laurie had made.

The resolution of thanks was then put, and carried unanimously.

Dr. LAURIE, in reply, stated he desired to correct one false impression which he seemed to have made, namely, he did not mean to imply that he thought the cracking of the picture was due to the movement of the canvas. He merely stated that he thought it right to begin experimenting at the groundwork, and find out whether the canvas did move and what movement it was capable of. That was obviously one point which must be investigated, because it was necessary to go step by step before any definite conclusion could be arrived at. Mr. East made the very interesting suggestion that the cracking was probably due to moisture between the layers of the pigment, the canvas being damp when the second painting was put on. That might be so; and he promised Mr. East he would make the experiment to see whether he could succeed in getting cracking in that way. As he had stated in his paper, it had been his misfortune not to succeed in getting cracking. Mr. East also suggested the painting of a quick-drying pigment over a slow-drying pigment. He actually put on some olive oil in the under coat and painted umber on the top, and it did not crack. It might produce cracking in certain conditions, but not necessarily. Mr. East also complained that he had not received much enlightenment, and that he wanted more practical information than he had obtained. He (Dr. Laurie) quite agreed with him. He stated at the beginning of his paper that he was afraid he would not be able to give any very final dictum on the point because the matters were not at all cleared up. The result of his experiments had been to show that the usual explanations did not account for the facts, but that they still had to be discovered, and would, he hoped, open up possibilities of investigation which he had not been prepared to give that evening. He quite agreed with Mr. East that it would have been very much nicer if he had been able to tell artists that if they did so and so certain results would follow. He could not follow Mr. Reid through all his interesting remarks. He was quite aware of the experiment he referred to, in which oxidised linseed oil had liquified; but it was impossible to reconcile that experiment with what happened in an ordinary picture, where linseed oil did not liquify, and where it was not mixed with a basic substance at all. The worst case of cracking that he had shown on the screen was on a canvas where ordinary white lead had been painted in the sky, and that had cracked. That was a case of a basic pigment in which cracking had taken place. In the course of his experiments he tried pigments of umber and ochres, which were apt to cause cracking, but they would not crack. The experimental evidence was not at all conclusive. Mr. Reid's suggestions were very ingenious, but, as far as his own experience went, they were not conclusive any more than the remarks Mr. East made. The matter required further investigation. With reference to the remarks that had been made about amber varnish, he simply took certain trade samples, with the results he had described. He quite agreed with Mr. Reid, that probably neither of the samples contained any amber at all, although they were sold as amber varnishes. He would be exceedingly obliged if Mr. Reid would send him a sample of the amber varnish made by the Prussian Government, in order that he might test it with his machine against the copal varnish. He did not think it was possible to go into the question of how Van Eyck painted his pictures. His own opinion was that

they were not painted with oils. Probably some present knew that the evidence which was given in the Italian records had been disputed, it being stated that the person who said he was taught by Van Eyck was born many years after Van Eyck died. He could not agree with anybody who said that Van Eyck's pictures were painted with ordinary oil pigments, because he did not think the result could be obtained with them. For one thing, he did not understand the condition of the verdigris; and he believed he was supported in his opinion by a great many other chemists. The two oils used in the experiment he conducted at the meeting, were bought in the open market. He bought a sample of artists' drying oils in an artist colourman's shop, and another sample in another shop. One turned out to be lead, and the other manganese, and in making the experiment he did not add any lead to the article as it was sold. The difficulty with regard to the liquifying of oil was that it did not seem to happen on pictures, and that he did not think the basic bodies would account for it. The tendency of linseed oil was rather to resinify than to turn into a liquified form, but he had not any clear evidence of its doing one or the other. If any artist possessed old cracked pictures which he no longer regarded as of any value, he (Dr. Laurie) would be extremely obliged to receive them, so that he might cut them up into sections, and put them under the microscope.

THE BRITISH INDIAN COMMERCIAL MISSION TO SOUTH-EASTERN PERSIA.

II.

Statistics.

Trustworthy statistics are difficult to obtain, except in the Customs Reports for recent years, and in this respect it must be admitted that there is a great improvement in the figures of the Belgium Administration of the Persian Customs. They declare the total trade of Persia in 1902-03 to have been over £8,000,000, consisting of over £5,000,000 imports and £3,000,000 exports. Other reliable information makes it fairly evident that these figures rather underestimate matters, and that the total imports and exports averaged £9,000,000 annually. Of this trade £4,000,000 was, roughly, with Russia, £3,000,000 with the British Empire, and £2,000,000 with other countries.

The official statistics for 1903-04, are less satisfactory for us though they show a considerable increase in the total trade of Persia, which amounted to £10,661,695, imports being £6,415,609, and exports £4,246,086. Russian trade shows a very substantial increase, while British on the other hand shows a falling off, and amounts to only £2,490,000. Both Russia and Britain preponderate enormously. When it is considered that Russia trades in particular with the northern parts of Persia, which are undoubtedly richer and more prosperous than the south, that Persia is her next-door neighbour, that the trade has not only been assiduously nourished, but "spoon-fed," and that Englishmen have to work against a tariff which has been especially planned to kill our trade and foster that of Russia, the figures are not so discouraging. Improvement could be made by an expansion of existing trade, the opening out of new connections in unexploited parts of Persia, and beating Russia by her own methods, if necessary, *e g.*, by special rates for freight, subsidies and rebates. It must be borne in mind that the proportion of our trade which would need thus bolstering would be very small in proportion to our entire trade, whereas with Russia the reverse is the case.

Fluctuations of Trade.

In Persia, as in India, the yearly fluctuations of trade depend chiefly on meteorological conditions and on the consequent economic position of the people. In 1900 and 1901 the winter rains, on which the life of Persia depends, practically failed. There was a consequent and immediate shrinkage of the already too scanty cultivation all through Southern Persia, which region has not yet recovered from the effects of the drought and a corresponding shrinkage in Persian trade. To draw any valuable conclusions, therefore, the figures and meteorological facts must be studied over extended periods of time.

Judging from reliable critical estimates and information it is evident that the trade of Persia, alike in imports and exports, has increased within the last few years by from 15 to 20 per cent. This increase, has, however, been for the most part in the north of the country and in Russo-Persian trade.

Sugar comprises one-half of the Russian exports to Persia. The consumption of sugar in Persia is enormous, and she produces none herself. Beet-root cultivation has been tried, but with no success to speak of. Owing, however, to the fact that over a great portion of Persia Russian sugar is unsaleable, Russia contemplates claiming certain concessions for the growing of beet-root and the manufacture of sugar in Persia. If, however, through rates can be secured and a careful study made of national taste, Indian sugar, both crystal and loaf, should oust the French, Egyptian, Austrian, and Belgian products, which flood the southern half of Persia. Indian sugar has greater sweetening power and purity than the above-named manufactures. In tea, the trade could be largely developed by careful study, and by shipping a moderately-priced and light-liquored article, for the latter is that to which Persian taste has been educated. In yarns and twists, India holds a very firm position, but this might be improved still more if she could manufacture some finer grades; similarly, India might be able to get in more cotton goods and prints than she does now, and secure almost a monopoly in woollens.

The shipping companies and railways must do their

share by granting special and reduced through rates, a thing they can well afford for goods intended for Bander Abbas and Bushire, as is now done for goods for carriage over the Quetta-Nushki route to Seistan. The Persian Government should be exhorted to bring about an improvement in the Port of Bander Abbas, and construct a good caravan road to Bam, over which wheeled traffic would ply, or to grant a concession, as in the case of the Bakhtiari road (Lynch road) to some English firm. A little rational irrigation in the plains of Bam-Narmashir, Jiruft and Rudbar, coupled with the foregoing, would mean a golden harvest for the Shah.

Russia's influence in the north is all-powerful and her proximity enables her to exert pressure in Teheran. Her consuls in some cases virtually rule Persian provinces, and neither the Court nor the people find cause for objection, for are there not the Cossacks over the border, and the railway tracks leading up to Moscow and St. Petersburg, with the immediate prospect of motor cars running direct to Teheran, for which a concession has been granted to Russia. In the South, Russian consulates and agencies are being opened. Many of the Persian Customs officers keep Russian officials and merchants *au fait* with Persian trade and act as agents for the spread of Russian goods. The Belgians, their supposed neutrality notwithstanding, are or were naturally more in sympathy with Russia than with the British, by whom they are regarded with some suspicion.

Fortunately the Indian Government are alive to the importance of trade with the countries beyond the Indian frontier.

As to Persia's exports, three-quarters or more of these are raw produce, vegetable and animal, the main part going to Russia. The vegetable products, which comprise dried fruits, raw cotton, opium, rice, gums and dyeing materials, are capable of great improvement; the animal products consist mainly of silk, cocoons, skins, pelts, intestines, wool, and pearls. The remaining fourth part comprise chiefly carpets, with a very small quantity of leather goods. The best of the Persian carpets are made in Kerman and are exported to India, the United Kingdom, Turkey, Europe generally, and America; cotton, silk, and woollen tissues go to India, Afghanistan, and Turkey; and leather goods to Russian Turkistan. Amongst articles which might be more largely exported to India are wool, cotton, pistachios, almonds, raisins, gum tragacanth, and various dyeing materials.

As to mills or factories it would be hopeless for any Indian or English manufacturer to think of establishing works in Persia at present, the chief difficulty being the stringent rules under which it is permitted to foreigners to own houses or land in Persia, and after that the great cost of transporting machinery inland. A good road, though fit for wheeled traffic from Bam to Kerman, would help to change matters very soon.

TRADE METHODS.

Trade methods vary in Persia, those in Central Persia being somewhat different from those obtaining in Kerman and the South-Eastern region. Sales in Yezd and Ispahan are made when wholesale, on the basis of a fixed price with long credits which operate in the nature of a discount, which varies in proportion to the fluctuation in market price.

The great drawback to trade, apart from the state of the country and communications, is the absence or rather the primitive state of commercial law in Persia. For the term law may be read custom, assisted by the Koran and complicated by bribery and corruption. The payment of accepted bills cannot be enforced, and bankruptcies, many of them fraudulent, are common amongst the smaller fry of traders who, on very slight provocation, take refuge in the sanctuaries or refuges, called *Basts*, which abound in the country. Such bankruptcies are more rare among the bigger merchants, who are made to pay very heavily for the privilege of taking Bast by the mullahs in charge, and Bast is at best little better than prison.

BANKS AND BANKING.

There are two European banks in Persia. The first is the Imperial Bank of Persia, an English concern; the other is Banque d'Escompte et des Prêts, which is connected with the Russian Government, managed by a Russian Government official, and is practically a department of the Russian Government. The former has about ten branches and ought to have one at Bam, as well as one at Bander Abbas, which would be beneficial both to the Imperial bank and to British trade.

Besides the two banks there are many money-lenders, viz., Shikarpur Hindus, Armenians, and Mohammedan Shroffs. Although the Koran forbids Mohammedans to lend money on interest, they find a way out of the difficulty by charging, in lieu of interest, a premium as consideration for the favour of the loan. The mortgaging of land is common, but the holders of the deeds are as a rule very glad to assist their debtors to resume possession, especially when these debtors are the heirs of a dead mortgager. Mohammedans think that property acquired under such circumstances carries with it a specially deep curse.

Banking as yet has not taken a firm foothold in Persia, the natives being bewildered by calculation of rates of exchange, of discounts and interest. Content to eat, sleep, and be merry after their own fashion, as long as they can do so without feeling the pinch of want, they are glad to let others do the banking. Among such people, centuries behind European business habits, banking must be a difficult affair and of slow growth.

Persia is a silver country and its monetary unit is the kran, a silver coin worth now about fourpence. Recently a nickel coinage consisting of $\frac{1}{20}$th and $\frac{2}{20}$ths of a kran has been minted in Belgium for the Shah and all copper coins withdrawn. The Persian mint

issues at various times, gold coins of various values from 5 krans up to 10 tomans (1 toman is equivalent to 10 krans or 200 shahis). These coins are, however, not legal tenders. The Imperial Bank issues notes of tomans 1, 2, 3, 5, 10, 20, 50, 100, &c., and these are legal tender. This bank, which is the only institution in Persia with a legal right to issue notes, has a circulation exceeding in value £500,000 sterling. But owing to various reasons of which the chief is the extreme costliness, slowness and insecurity of transport over Persian roads, and for other reasons the bank has now been compelled to limit the encashments of notes to their own circles, except, of course, for small sums, or, at a very heavy discount, to travellers.

THE ROUMANIAN TOBACCO INDUSTRY.

The tobacco monopoly in Roumania was created in 1864, when the State reserved the right of sale of foreign and native tobaccos of all qualities and forms, and of cultivation. A special authorisation was necessary for its cultivation by private individuals, and so strong was the opposition that the law was repealed in 1867. In 1868 the cultivation became free, except for a certain tax. The trade in manufactured tobacco and the exportation of native tobacco were free. This lasted until 1872, when the State once more reserved the right of cultivating, manufacturing, and selling tobacco throughout the country. The monopoly was given to a company for fifteen years, divided into periods of five years each, with an increase of 20 per cent. on the payments of the company to the State for each period. According to the American Consul-General at Bucharest, from 1872 to 1877, the company paid to the State £324,000 a year for the monopoly. It decreased the amount of land under cultivation, and limited it to certain districts. The average was not more than 6,750 acres, producing about 3,750 tons of tobacco. During the first two years the company lost £160,000, but in 1875 it made £40,000, and in 1876 only £5,720. There were many complaints from the consumers about the inferior quality and the cost of the tobacco. In 1878, the company gave up its contract, and sold out to the State for £145,500. In 1880, the present administration was organised under a new law. Each year, in October, the administration gives notice by advertising, of the districts in which the cultivation of tobacco for the next year will be allowed, the area which may be cultivated, and the price which will be paid for each quality. Any person wishing to grow tobacco applies to the mayor of his district and the administration signs a contract with him if the conditions are satisfactory. The amount of land to be cultivated is fixed and must be sown with seed which the administration supplies grown in each region. Any variety not allowed is destroyed, and if any is found later the cultivator is fined and his contract annulled. The cultivation of tobacco commences in the month of March, when the seed is sown in the open ground and carefully covered during cold weather. When the plants have five or six leaves they are replanted in rows 20 to 30 inches apart, and 8 to 16 inches between plants. When the leaves begin to get dry and yellow the picking commences from the bottom up. As the best leaves are those which get yellow the slowest, delay is encouraged by cutting and pinching certain parts of the plant. The leaves must be gathered in dry weather and in the evening. They are taken to a dry place and pressed with their tips free, for from twelve to twenty-four hours, in which time they commence their first fermentation. Every day the agents of the administration check the number of bundles hung up. Along with the gathering and drying, the agents of the administration weigh the crop in the presence of the mayor of the district, and receipts are exchanged. Every bundle missing is estimated at five shillings, which is deducted later from the payment to the cultivator. Ten per cent. loss on the first weight is allowed at the time of delivery to the administration in November and December, and for every pound less than that a fine of one shilling and eightpence is exacted. Delivery is made in the presence the cultivators, where each bale is opened and weighed, after a careful examination and classification of the tobacco. The amount to be paid to the cultivator is finally settled. Three varieties of tobacco are grown in Roumania, two of which, the Persicean and Iaka, were brought from Macedonia, and the third, Samsun, from Asia Minor. The seed for the Iaka is imported each year from Macedonia. Experiments are being carried on with tobacco from Hungary and Herzegovina with fairly good results. There are experiment stations in various parts of the country with a view to improving the quality of the tobacco grown and to introducing new varieties. The cultivation of tobacco is also helped by the administration in a variety of ways, as by the establishment of funds for the assistance of the cultivators by lending sums of money varying from £8 to £24 for the construction of drying sheds and store rooms, by annual prizes of cattle, machinery, fruit trees, money, &c., and by making good any losses by hail or fire. Cultivators are also able to obtain the materials and implements necessary on the instalment plan. During the last year the administration has started an experiment station at Bucharest, with a library, laboratory, and trial fields. A bulletin is published every month giving the results of the experiments made and articles on the cultivation. The dried tobacco delivered by the cultivators has to be fermented in order to acquire the aroma and special properties for smoking. This takes place in the spring of the year following the gathering in separate sheds. The best qualites of tobacco receive particular attention, while the inferior sorts are fermented in masses. During the process the temperature goes up to about 90

degrees or 100 degrees, gas being created, the disappearance of which indicates the end of the operation. The leaves are then packed in bundles weighing some 65 lbs., and sent to the central depot in Bucharest, where they are kept until sent to the manufactories. There are six fermentation depots. The total amount of the raw tobacco used in Roumania is 4,250 tons, valued at £224,000, of which 625 tons, costing from £80,000 to £120,000, is imported. Some 80 per cent. of the latter comes from Macedonia and Asia Minor, and 125 tons from America, Sumatra, Java, Japan, and Hungary. The purchases are made by open bidding from samples presented by the sellers. When the tobacco from the fermentation depots arrive at the factories, it s sorted with care and the different qualities are mixed in the proper proportions. In 1905-6 the output was 35,957 tons of smoking tobacco, 264,000,000 cigarettes, 11,625,000 cigars, 207 tons of snuff, and 559 tons of tobacco juice for insecticides. The total value was £1,650,000. The net revenue of the monopoly for the last year for which the statistics have been published was £1,136,000.

THE PROGRESS OF SOUTHERN ITALY.

The year 1906 witnessed three important events in the commercial history of Italy. It saw a surplus of 40,000,000 lire (£1,600,000) in the Italian Treasury; the conversion of the 5 per cent. Rente was successfully carried out; and the eruption of Vesuvius, which had the effect of swelling the tide of emigration to the extent of depopulation in some cases, and caused the agricultural population of the Central Provinces to emigrate to the South in search of work. Successive Governments, ever since the unification of Italy, have had to reckon with serious deficits, but not only was there a substantial surplus last year, there is every probability of its being larger this year. The conversion of the Rente into 3¾ per cent. for five years, to be subsequently reduced to 3½ per cent., has effected present reduction in the payment of interest on the debt (£324,000,000) of £800,000 per annum, and five years hence the reduction will be £1,600,000. There was much discussion after the eruption of Vesuvius as to the desirability or otherwise of re-building the destroyed towns. It was thought by many that it would be better to select a site in the plain further away from the mountain, and with greater railway facilities. But the population insisted upon the actual re-building of their old houses, and the close of 1906 saw a very large portion of the inhabitants installed again on the old sites, so that it is safe to predict that in the course of a year from the date of what appeared to be their absolute destruction both Ottajaro and San Giuseppe will rise again from their ashes.

In his report upon the trade of Southern Italy just issued (Cd. 3283) Mr. Consul-General Néville-Rolfe directs attention to the great development of the Port of Naples (which now holds the third place in Italy as far as merchandise is concerned), whose tonnage has risen from 893,216 tons in 1895 to 1,292,201 tons in 1905. The increase in shipping in the same period has been still more remarkable, having risen from 3,523,991 tons in 1896 to 10,000,000 tons in 1905, an increase due to the mail and passenger traffic, which has raised it to the first place among Italian ports, while taking passengers and goods together, it now holds the second place, being only surpassed by Genoa. It is believed that the maritime importance of Naples must continue to develop, and the Italian Government has voted £564,000 for the further development of the port and quays. A new steam basin is also to be made to the east of the existing harbour, for which £500,000 has been voted in addition, and in order to render this basin a safe anchorage, a large breakwater will have to be constructed at once. The new Custom House for passengers, which seemed so handsome and vast in comparison with its small and shabby predecessor, is now quite insufficient for the purpose of clearing the baggage of the large number of passengers which arrive by the great liners of to-day, and it will be necessary to make a new hall.

The large trade done in silk from Italy to Egypt has become an important factor in Italian trade. Nowadays, Egyptians earn money easily, and they spend it freely. Formerly, nearly all their silk came from France. Now the French manufacturers are being hard pressed by the Italians, the Egyptians preferring the greater lightness of Italian goods, and the lower price. A new Italian product, called the "silk zephyr," which was first exported to Alexandria four years ago, has proved a striking commercial success. It is a light fabric, made in various designs, traversed with a light cotton thread which is sufficient to give it the required consistency for dress fabrics, and its cost is from 1s. to 1s. 10d. per metre f.o.b. at Alexandria. The width is 28 inches, the exact width of the French being 20 inches, and it is the additional width, and the showy stripes of the Italian product which appeal especially to the Oriental mind. Italian trade with Crete, too, is growing rapidly, the Italians holding an important place in the cotton goods market in that island. There is a strong export of textiles from Italy to Crete. The trade is of very recent growth, having been hampered for want of direct communication, now improved. A direct line will, in all probability, be shortly established. The success of Italian goods in Crete is only a part of her rising trade with Syria and the Levant generally, where Italy's goods are annually taking firmer hold.

The great increase, in recent years, of tobacco cultivation in Italy has led the Finance Minister to consider a scheme whereby the country should be able to grow all the tobacco necessary to furnish this important Government monopoly. At present, large quantities are imported from America, but as the Kentucky variety is found to do remarkably well in Italy, experts have been sent to Sardinia, Sicily, and

to various places near Rome and Casentano, to instruct the peasants in the cultivation of the plant, and to induce them to allot a portion of their ground to growing it. The cultivation of india rubber has also begun. The india rubber tree grows freely in gardens as an ornamental shrub in Southern Italy, and steps are being taken to make an industrial business of it. It is a plant which will do with dry weather, but flourishes more with irrigation, and as most of the cultivated land of Italy is irrigated it should do well if the climate is warm enough.

Perhaps in no country has there been a more remarkable development of the automobile industry. In 1903 there was only one firm of automobile manufacturers in Italy, and its capital was only £120,000. In 1904 seven more firms entered the list. In 1905 the total number had risen to 51, and the capital now employed in the industry amounts to an enormous sum. Italian motors, both on land and water, have proved themselves admirably adapted both for speed and resistance. The principle hitherto adapted only for sport and light vehicles is extending to commercial uses with great rapidity, and agriculturists have not been behindhand in adopting it to the purposes of their industry.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in January :—

New Charts.—3643—Ports in the Shetland islands: —Balta harbour. 3600—Japan: achorages in Yezo island:—Yesashi anchorage; Abashari anchorage; Nemoro anchorage.

New Plans and Plans added.—Africa, north coast; Bizerta lakes. Plan added:—Lake Bizerta.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiand telegraph chart. 2151—River Thames:—Broadness to Mucking light. 2298—Gulf of Bothnia, sheet III.:—Nystad light to Stor fiord. 2300—Gulf of Bothnia, sheet V.:—Stiernö point to Fiärderäg. 1073—France, north coast:—Dieppe. 909—North American lakes:—Mildrum point to St. Joseph island. 373—Plans in the gulf of Mexico. 2458—Alaska:—Port Simpson to Cross sound. 3569—Alaska:—Port Valdez. 643—Africa, south coast:—Port Natal. 1000—Siam:—Pulo Condore group. 1342—Cochin China:—Fan rang bay to Tonking gulf. 1602—China, east coast:—Approaches to the Yang-tse-kiang. 3585—China, east coast:—Approaches to the Woosung river. 3274—Yang-tse-kiang:—Tung ting lake and Siang river. 1256—China, north coast:—Gulfs of Pe chili and Liau tung. 2405—Russian Tartary:—Kuril islands to Kamchatka. 691—Australia, east coast:—Normanby sound and Prince of Wales channel.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

The Wool Trade.—Notwithstanding the heavy direct arrivals of Colonial purchases, the second series of Colonial wool sales saw no reaction in prices. The trade is still able to lift all the wool that is offered provided the quantity offered is not rushed too heavily upon customers, and the prudent action of selling brokers in limiting the offerings at the March sales to 150,000 bales had much to do with the maintenance of prices. However good business may be—and it was never better in wool than to-day—the trade cannot be gorged, month after month, without prices being affected, and with the limit of the March sales applied to those of May, the trade is given a chance to finance all arrivals. The quality of the Australian clip is unusually high, and with abundance of wool, and high prices, there is a record in the history of the wool trade. The amount of capital required to lift the same number of bales in 1907, is very different to what it was in, say, 1895. In the latter year, the average price per bale was £11, and the total value of the Australian and Cape wool clip was £24,970,000; in 1906 the clip was only 2,071,000 bales, but the average value per bale had risen to £17, and the total value to £35,207,000, that is to say, the price had risen over 50 per cent. 1907 is certain to break all records in the sum required to lift the wools which are, and will be, available. The manufacturing world is more hungry for wool than it has ever been, and it looks as if the trade is nothing near filled up. The character of the offerings has been very good, both merinos and crossbreds being first rate. The good general buying by all sections of the trade has been one of the leading features of the series, and the way merinos have sold proves the popularity of fine wools, and in centres like Bradford there is far higher pressure in merino departments than crossbreds. The New Zealand clip this season is rather shorter than usual, and this has driven competition on to well grown, deep stapled, lustrous qualities. Probably top prices have now been reached for a time, but current rates are likely to remain steady, which is much more desirable than a rush being made to be followed by a serious fall. The present is a consumers' market, which is much better than any speculative boom. Whether the weight of offerings will break prices remains to be seen, but there is a stronger feeling of safety in present values than if prices were forced to a higher level. On the whole the outlook is sound, for consumption is undiminished, and stocks are *nil*. The woollen and worsted industries were never in a more healthy condition.

The Shipping Industry and the Workmen's Compensation Act.—Just as the Workmen's Compensation Act renders employers of domestic servants liable for compensation under a much wider range of circumstances than is generally supposed,

so it would seem to impose responsibilities upon the shipping industry of a very far-reaching character, and not as yet generally appreciated. The opening words of the Act show that it does not lay down any limits within which an accident must take place in order to make an owner liable for compensation. They run :—"If in any employment personal injury by accident arising out of and in the course of the employment is caused to a workman, his employer shall be liable to pay compensation." There is nothing here to limit liability for compensation to employment in the United Kingdom. "Any employment" can only mean employment at home or abroad unless specifically limited by some clause of the Act to the United Kingdom, and there is no such limitation. It covers employment in any part of the world, employment by a railway company in Argentina having an office in England; by a mining company in, say, the Transvaal with an office in London; by a tea or rubber company in Ceylon, to be found at an office in London, though it be confined to a single room. And in the case of shipowners, if the contention of a legal correspondent of *The Times* (March 25) is correct, the Act applies to every foreign shipping corporation which has an office in the United Kingdom. There is no territorial limitation upon the applicability of the Act, says the correspondent, any such suggestion of this kind is at once dissipated by the express provisions of Section 7, which seems to show that the Legislature actually intended to make the presence of the employer within the United Kingdom at least the principal test. Section 7 commences with this provision, "This Act shall apply to masters, seamen, and apprentices to the sea service, and apprentices in the sea-fishing service, provided that such persons are workmen within the meaning of this Act, and are members of the crew of any ship registered in the United Kingdom, or of any other British ship or vessel of which the owner or manager resides and has his principal place of business within the United Kingdom," subject to certain modifications which relate merely to procedure and subsidiary matters. Whether "a vessel" brings foreign shipowners within the provisions of the Act is by no means clear. If these words are so interpreted by the Courts there is likely to be considerable international friction, but whatever may be the case with the foreigner the Act makes the liability of the British shipowner clear beyond dispute. It looks a serious liability, but the shipowners did not protest very strongly against it during the discussion of the Bill in Parliament, so that it must be assumed that they do not anticipate any very serious payments under it, or forseeing them, see their way to meet them by insurance without serious strain.

Insurance Businesses.—The Board of Trade has just issued its annual insurance returns. The Mutual Reserve Fund is the only one noticeable by its absence, this notorious American concern having closed its offices in the United Kingdom. No notice was given to the policy-holders of the intention to close, and there must be a good many policies still running in this country. The company will no doubt meet its obligations upon them, but it has no assets here, and its record supports the recommendation of the House of Lords Committee that life assurance companies, with their head offices outside the United Kingdom ought to be required to keep a permanent deposit with the Court of Chancery. The returns now published are, for the most part, to the end of 1905. A few offices have brought them down to June, 1906; and the Friends Provident are down to November 20th, 1906. It would be more convenient if all the companies would end their financial year with December, and there seems no good why they should not be required to deposit their accounts by March 31st of the succeeding year. Even in 1905, amalgamations and transfers were numerous. The Provident Life was transferred to the Alliance; the Westminster and General to the Guardian; the Scottish Imperial to the Norwich Union Life; the Patriotic to the Sun Life; and the Yorkshire Provident to the United Provident. Last year this process of transfer and amalgamation was even more considerable, and 1907 promises to see further concentration, which can hardly be in the interest of the public. For apart from a Colonial company, the Federation Life of Toronto, only three new offices were added to the official list in 1905. The official summaries for the year showed that the premium income from ordinary business had reached £25,332,993, and from industrial £11,619,303, making a total of £36,952,296. In the course of twenty-six years the ordinary life business rather more than doubled. The increase in industrial business has been much more rapid, and the Prudential maintains its pre-eminent position. Of the total industrial premium income of £11,620,000 over £6,000,000 was received by the Prudential, while out of industrial life funds amounting to £31,000,000, the Prudential held £24,000,000. The total number of ordinary policies in force, as given in the Blue-book, was 2,068,878, giving an average of about £345 to each policy. The number of industrial policies was 25,544,045, assuring a fraction under £10 each. These industrial policies, taking the average, are little more than sufficient to pay funeral expenses. It is therefore obvious that there is still a vast number of persons in the United Kingdom, dependents, for whom no provision is made by way of life insurance. The rate of interest received in 1905 upon the ordinary life funds was £3 15s. 4d., as against £4 4s. 8d. in 1880, and upon the industrial funds £3 8s. 9d., as against £3 7s. 6d. in 1880. The accounts for 1906, so far as they have been published, show a higher return upon investments, but there has been considerable decrease in the capital value of investments, due to the low price of the securities held by insurance companies.

The Channel Tunnel and Traffic.—The refusal of the Government to approve the Tunnel Channel scheme was not unexpected. Opinions differ as to whether it could have been profitable to the company that constracted and worked it. The estimate of cost was £600,000 per mile. No doubt a good many travellers would have availed themselves of it, especially in bad weather, but if it had secured the whole of the trade now carried on between Dover, Folkestone, Newhaven, and France—it is highly improbable that it would have secured any traffic from France west of Dieppe, or diverted any between London and Belgium, Holland, and Germany—it would only have carried—assuming that the authorized maximum British mileage rates had been charged according to the various classification of the goods—imports and exports bringing in a revenue of £82,000. It is only goods of high value but small in bulk, and perishable goods, that are put on a railway, or sent by rail and steamer when direct carriage by sea is possible. Four-fifths of the trade of London, for example, come and go by sea direct, and a channel tunnel could not hope to divert any of it. There is the passenger traffic, but whether in these days of turbine boats the majority of travellers would have availed themselves of the tunnel is doubtful. Of course its advocates contend that it would attract much new traffic from both sides, and no doubt some would be attracted. But to what extent could only be settled by actual experience.

The Cotton Industry.—Easter finds the outlook for this industry still healthy. The latest advices from America make it likely that the supply of the raw material for the season ending next August will be the largest upon record, even exceeding that of two years ago, whilst the reports from other countries are encouraging. There are 1,964,000 bales in the ports, and 380,000 bales afloat of American, against 1,603,000 and 258,000 respectively last year. East Indian descriptions will be in larger supply than for some years back. The experiments of the Government of Bombay in Scinde have established that the higher grades of cotton can be grown there, and it is estimated that the substitution of Egyptian cotton in India for the indigenous varieties will increase the value of the yield. The quality of this Egyptian cotton grown in Scinde has been reported upon favourably in Manchester. In Egypt itself the crop is expected to be larger than last season. The demand for abroad is satisfactory. India is taking large supplies of Lancashire calico, as are Egypt, Italy, and South America. The only cloud in the sky, and that at present is not very menacing, is the refusal of the cotton weaving employers to pay the 5 per cent. advance in wages demanded by the workpeople. The masters have consented to an adjournment for a month, but it is understood that they will not give way. The differences have not as yet become acute.

GENERAL NOTES.

THE PROGRESS OF CANADA.—The fourteenth annual report of the Department of Trade and Commerce, Ottawa, bears testimony to the continued and rapid growth of the trade of the Dominion. During the year covered by the report there was an increase over the previous year of more than 80,000,000 dols., made up of about 27,450,000 dols. imports, and 53,270,000 dols. total exports. Both the increases in imports and exports were pretty well distributed over all classes of goods. They are, however, most noticeable as regards exports, each class or division havin participated in the increase. Nor is it only in figures of imports and exports that the prosperity of the Dominion is marked. Bank clearances, deposits, &c. are equal indicators, and are equally in evidence. Thus the total deposits in Banks increased from 555,640,068 dols. in 1905 to 626,079,335 dols. in 1906; the amount of insurances in force from 587,810,790 dols. to 630,334,240 dols.; the number of letters sent from 29,941,000 to 33,674,000; the freight carried on railways from 50,893,957 tons to 57,960,713 tons. Population, too, has increased beyond all precedent.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

APRIL 10.—"Arts and Industries in Hungary in Ancient and Modern Days." By LOUIS FELBERMAN. SIR JOHN CAMERON LAMB, C.B., C.M.G., will preside.

APRIL 17.—"Aerial Navigation." By MAJOR B. F. S. BADEN-POWELL.

APRIL 24.—"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon. LIEUT.-COL. DAVID PRAIN, C.I.E., F.R.S., will preside.

MAY 1.—"The Defence of the Sea Coast from Erosion." By ALFRED EDWARD CAREY, M.Inst. C.E.

MAY 8.—"The Production of Coke and its Application in Domestic Fires." By PAUL SCHLICHT. CORBET WOODALL will preside.

MAY 15.—"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

APRIL 23.—"Social and Economic Conditions in Australia." By the HON. JOHN WINTHROP HACKETT, LL.D.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. HALSEY RICARDO will preside.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON. J. C. WEDGWOOD, M.P., will preside.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

April 15, 22, 29.

LECTURE I.—APRIL 15.—Water in its relation to laundry work—Hardness of water and softening agents—Treatment of boilers showing pitting—Soaps and their composition—Easy methods of examining and valuing soaps—Behaviour of soaps with water—Hydrolysis of soaps.

LECTURE II.—APRIL 22.—The alkalies used in laundry work — Their relative values and useful strengths—Bleaching agents—their composition and properties—Methods of applying bleaching agents—Their comparative value—Dangers in the use of bleaches—Methods of valuing bleaches.

LECTURE III.—APRIL 29.—The problem of washing—Textile fabrics: easy methods of distinguishing between them chemically and by the microscope—Shrinkage of woollen goods—Behaviour of various fabrics with detergents and bleaching agents—Influence of acids, alkalies, &c., on the individual fibres—Precautions to be observed.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 8. Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Messrs. B. H. Thwaite and R. F. Thorp, "The Renard and Sourcouf Road-Train System."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. Mr. H. de Mosenthal, "Observations on Cotton and Nitrated Cotton."

Surveyors, 12, Great George-street, S.W., 8 p.m. Messrs. W. Vaux Graham and Harold F. Bidder, "Underground Water. A Discussion of certain recent enactments affecting Water Rights."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Stanley Hamp, "Hotels."

Medical, 11, Chandos-street, W., 8½ p.m.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. H. B. Guppy. "Plant Distribution from an Old Standpoint."

TUESDAY, APRIL 9. Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Howard Candler, "How the Elephant became a Bishop; a study into the origin of the names of Chess-Pieces." Exhibits (figures in alabaster) by Mr. E. Herbert Fyson and Rev. E. S. Dewick.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. G. H. Bryan, "Wings and Aeroplanes." (Lecture I.)

Alpine Club, 23, Savile row, W., 8½ p.m.

Designers, in the Galleries of the Royal Society of British Artists, Suffolk-street, Pall-mall, S.W., 8 p.m. Mr. H. Inigo Triggs, "Garden Design in Italy."

Medical and Chirurgical, 20, Hanover-square, W., 8.30 p.m.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Discussion on (1) Mr. Moses Kellow's paper, "The Application of Hydro-Electric Power to Slate Mining;" and (2) Mr. Arthur Henry Preece's paper, "Electrically Driven Winding Gear and the Supply of Power to Mines."

Photographic, 66, Russell-square, W.C., 8 p.m. Messrs. E. J. Wall and C. P. Butler, "The Spectroscope" (Part I.)

Zoological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. The Hon. J. W. Hackett, "Federal Tendencies and Developments."

WEDNESDAY, APRIL 10...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. L. Felberman, "Arts and Industries in Hungary in Ancient and Modern Days."

African, Criterion Restaurant, Piccadilly, W., 8 p.m.

Japan Society, 20, Hanover-square, W., 8½ p.m. The Baron Dairoku Kikuchi, "Female Education in Japan."

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, APRIL 11. Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Professor H. A. Miers, "The Birth and Affinities of Crystals." (Lecture I.)

Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, APRIL 12...Royal Institution, Albemarle-street, W., 9 p.m. Prof. A. H. Church, "Conservation of Historic Buildings and Frescoes."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. (Students' Meeting.) Mr. R. W. Allen, "An Engineer's Visit to Japan and Canada."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Educational Value of Museums."

Astronomical, Burlington-house, W., 5 p.m.

Architectural Association, 18, Tufton-street, Westminster, S.W., 7½ p.m. Mr. J. A. Marshall, "Westminster Cathedral."

Clinical, 20, Hanover-square, W., 8½ p.m.

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Discussion on Mr. Worby Beaumont's paper, "Petrol Motor-Omnibuses."

SATURDAY, APRIL 13...Royal Institution, Albemarle-street, W., 3 p.m. Professor Silvanus Thompson, "Studies in Magnetism." (Lecture I.)

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FRIDAY, APRIL 12, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 15, 8 p.m. (Cantor Lecture.) PROF. HERBERT JACKSON, "Detergents and Bleaching Agents used in Laundry Work." (Lecture I.)

TUESDAY, APRIL 16, 8 p.m. (Applied Art Section.) A. ROMNEY GREEN, "Joinery and Furniture Making."

WEDNESDAY, APRIL 17, 8 p.m. (Ordinary Meeting.) MAJOR B. F. S. BADEN POWELL, "Aerial Navigation."

Further details of the Society's meetings will be found at the end of this number.

MULREADY PRIZE.

The Council of the Society of Arts are prepared to offer, under the terms of the Mulready Trust, a Gold Medal, or a prize of £20, for competition amongst students of the Schools of Art of the United Kingdom, at the Annual National Competition to be held in 1908.

The prize is offered to the student who obtains the highest awards in the following subjects:—

(*a*.) A finished drawing of imperial size from the nude living model.

(*b*.) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses (mounted on not more than two imperial size mounts).

(*c*.) A set of studies of hands and feet from the living model (mounted on not more than two imperial size mounts).

(*d*.) Drawing from the life, including memory life drawing done at the Examination in May, 1908.

No student will be eligible for the award who does not pass in the Examination (*d*) in drawing from the life, and who does not obtain an award for (*a*) the finished drawing of imperial size from the nude living model. The other two subjects are optional.

The works must have been executed between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1892, 1893, 1896, or 1903, cannot compete again.

The drawings, &c., are to be submitted, with other school works, in the usual manner to the Board of Education, South Kensington, in April, 1908. Each competing drawing must be marked "In Competition for the Mulready Prize," *in addition* to being labelled according to the Regulations of the Board of Education.

STOCK PRIZE.

FOR THE DECORATION OF PART OF THE INTERIOR OF A BUILDING.

The Council of the Society of Arts are prepared to offer, under the terms of the Stock Trust, a Gold Medal, or a Prize of £20, for competition amongst the students of the Schools of Art of the United Kingdom, at the Annual Competition to be held in 1908.

The Prize is offered for the best original designs for an Architectural Decoration, to be carried out in painting, stucco, carving, mosaic, or any other process.

This Architectural Decoration is to be for the side of a room or a hall, a ceiling, the apse or side of the chancel of a church, or any suitable part of the interior of a building.

The designs must be on imperial sheets. Each set must consist at least of a coloured drawing to scale of the whole design of decoration, and two coloured drawings of details on separate imperial sheets. Mere patterns or sketches of details, without the mouldings or borders necessary to make up a complete decorative scheme, will not be taken into consideration. The designs must have been made

between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1893 or 1897 cannot compete again.

The designs are to be submitted, with other school work, in the usual manner, to the Board of Education, South Kensington, in April, 1908. Each of the imperial sheets, forming a set of competing designs, must be marked, "In competition for the Stock Prize," *in addition* to being labelled or staged according to the Regulations of the Board of Education.

PROCEEDINGS OF THE SOCIETY.

SIXTEENTH ORDINARY MEETING.

Wednesday, April 10th, 1907; SIR JOHN CAMERON LAMB, C.B., C.M.G., member of the Council of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Broadbent, Denis Ripley, A.M I.E.E., A.M.I.M.E., Royal Societies Club, 63, St. James-street, S.W.
Davies, Henry A., The Hawthorns, Bradley, near Bilston, Staffordshire.
Edwards, Mrs. Helen Agnes, Flat C, Artillery-mansions, Victoria-street, S.W.
Fryer, Sir Frederic William Richards, K.C.S.I., 23, Elvaston-place, S.W.
Jayakar, Balaji Jagonnath, 41-43, New Wadi, Bombay, India.
Khaw Joo Tok, Penang, Straits Settlements.
Khoo Eu Yong, Penang, Straits Settlements.
Kirkham, Captain John Karkeek, Fontabello, Barbadoes, British West Indies.
Leckie-Ewing, William, Rupurara, Inyanga, Rhodesia, South Africa.
Lim Eu Toh, Penang, Straits Settlements.
Lim San Ho, Penang, Straits Settlements.
Lim Tek Suan, Penang, Straits Settlements.
Mackenzie, R. R., Belgaon Tea and Fibre Co., Ltd., Chittagong, India.
O'Conor, James Edward, C.I.E., Francesco, Church-road, Upper Norwood, S.E.
Ong Hun Chong, Penang, Straits Settlements.
Osborn, Lieut.-Colonel Philip Barlow, D.S.O., Zomba, British Central Africa.
Sarkar, Chandra Kumar, 31, Penang-street, Moulmein, Lower Burma.
Thio Siow Kong, Penang, Straits Settlements.
Thio Tiauw Siat, Penang, Straits Settlements.
Thomson, Sir James, K.C.S.I., M.A., Pea Hen Hotel, St. Albans, Herts.
Yeoh Ooi Gark, Penang, Straits Settlements.

The following candidates were balloted for and duly elected members of the Society:—

Anderson, James D., 17, Blakesley-avenue, Ealing, W.
Booth, Rev. James Henry, F.R.G.S., Maryport, Cumberland.
McIlwraith, Sir Malcolm, K.C.M.G., Ministry of Justice, Cairo, Egypt.
MacLean, John, 330, Smith-street, Winnipeg, Canada.
Muff, Henry, The Red House, Bexley Heath, Kent.
Wyllie, Hubert D., Cameron Septic Tank Co., 812 & 813, Monadnock Block, Chicago, Illinois, U.S.A.

The CHAIRMAN, in introducing the reader of the paper, said that Mr. Felberman was the Vice-President of the Hungarian Society of London, and there was no man alive who knew the history, the literature, the poetry, the arts and sciences, the scenery, and the sturdy people of Hungary, better than he did, while nobody was doing more to cement the friendship which had for so long endured between Hungary and this country.

The paper read was—

ARTS AND INDUSTRIES IN HUNGARY IN ANCIENT AND MODERN DAYS.

By LOUIS FELBERMAN.

HUNGARIAN ARTS.

A passionate love for Art, as well as for Music, is the birthright of every Hungarian. Right from the very earliest ages there were signs of great artistic taste and display amongst the Hungarians.

St. Stephen, the founder of the Hungarian Kingdom, and the introducer of Christianity into Hungary in the year 1000, had done a great deal during his 40 years' reign to encourage the arts and sciences of the country. He founded numerous bishoprics, abbeys and churches, both at home and abroad, the walls of which were adorned by the finest frescoes of the time.

Amongst his immediate successors, St. Ladislaus (1077-1095), the brave and chivalrous king, proved also a true patron of the arts, likewise his successor, Kolomon (1095-1114), the conqueror of Dalmatia. The last named monarch, owing to his great learning and scientific attainments, was commonly known as the "Book King."

That enlightened ruler Andrew II. (1205-1235), who granted to Hungary in the year 1222 the "Golden Bull" or the Magna Charta of Hungary, a few years after the charter was granted to England by King John, was also a great patron of the arts. Upon his return from Jerusalem as the leader of the Crusaders, he devoted a great deal of time to the re-organi-

sation of the State, and likewise to the encouragement of arts and science.

Unfortunately, owing to various internal troubles and strifes, but principally as the result of the Mongol invasion, the art treasures of the country perished and its edifices were reduced to ruins, and the Cathedral of Pécs alone bears witness to the high development of the artistic taste and splendour of that period.

The Basilica of Esztergom, built in the twelfth century, may also be considered of great artistic value, whilst the renowned church of Ják, with its noble porch, and the church of Lebény, and a number of other churches, are rightly famed in the history of art.

It may be of interest to point out here, that in those days the principal churches were erected right in the interior of the country, far away from any city; and these churches were so constructed as also to answer the purpose of places of refuge and defence against the repeated invasions of the Mongol hordes, and other tribes, and these circumstances no doubt accounted for the fact that most of the churches belonging to this period were destroyed during the country's struggles.

With the accession to the throne of Charles Robert of the house of Anjou (1308), the Italian renaissance art was introduced into Hungary both by Charles Robert, and during the long reign of his son Louis the Great, and for the next two centuries art and science prospered throughout the land.

We have only to look at one of those volumes belonging to the famous collection of King Matthias (1458-1490) known to history as the Corvina Library, and we shall at once be convinced of the highly artistic taste which was developed in those days. The wonderful ornamentation and the marvellous miniature paintings in those volumes, which were written on parchment, furnish the best proofs of the great love for art and perfection of workmanship which prevailed during the rule of this great king. No wonder that the Turks during their occupation of Buda attached such importance to the possession of this valuable collection, which consisted of 5,000 volumes.

The Hungarians will always be grateful to the present Sultan for having recently restored to the Hungarian nation a portion of this library, which had been scattered about his dominions and sacredly guarded there for centuries. The volumes were brought back to Hungary in a special train, and the occasion was marked by the greatest national rejoicings. The thanks of Hungary in this respect is due to that eminent Hungarian scholar, Professor Vàmbéry, who, with the consent of the Sultan, was entrusted with the task of searching throughout Turkey for these valuable volumes.

I understand from my friend, Mr. Joseph Offord, the well-known Egyptologist, that one of the MSS. belonging to this library is in the actual possession of Lord Leicester at Holkham Hall, and it is sincerely to be hoped that this will be restored in the near future to the Hungarian nation, the natural custodian of such a priceless document.

In a country like Hungary, where patriotism is as sacred as religion, it is quite natural that the artists of the Middle Ages should have paid equal attention to the execution of subjects relating to national and historical life, and these are represented by the frescoes at the Gisella Chapel in Veszprém and the Church of Turnicze, the latter of which shows an episode in the legend of St. Ladislaus. The fresco to be found at the Cathedral of Szepesváralja displays an ecclesiastical subject with a political background.

Of the monuments and public buildings of the fifteenth century, the Cathedral of Kassa and a few other village churches in Upper Hungary, as well as the beautiful Town Hall of Bártfa, in the same district, are the only relics of that period.

Amongst other architectural relics of the Middle Ages no doubt the most perfect specimen of the kind preserved is that of the Castle of Vajda-Hunyad, formerly the city and stronghold of that immortal Hungarian hero Hunyadi-János (father of King Matthias).

A replica in plaster of this building was exhibited at the Hungarian Millennial Exhibition, and also at the Paris Exhibition, where it commanded the general admiration of all, and was considered as the finest specimen of architecture preserved from mediæval times.

The Hungarian Government have lately raised a beautiful palace for the Royal Agricultural Museum in the town park of Budapest, after the pattern of this castle.

Amongst the artists belonging to the Middle Ages hardly any names of importance have been handed down to us, but Hungary is proud to be able to claim the famous Albert Dürer as one of her sons, for although Dürer was born at Nuremberg he was of Hungarian parentage. His father, whose name was Ajtós, was born in the town of Cyula, in the county of Békes, and resided there until he

migrated to Germany, where he took the name of Dürer, the German for the Hungarian name of Ajtós.

For over a century and a half whilst the Turks were either knocking at the gates of Hungary or had practically become its masters, the Hungarians had no time to devote to art, for to use the words of a famous poet, "They had to guard the country with their sword in one hand and to plough the land with the other."

With the final expulsion of the Turks (1699) the innate love of art made itself again potent, and two artists of great fame appeared on the scene in the persons of John Kupeczky (1676-1740) and Adam Mányoky (1673-1757), both of whom established a world-wide reputation, John Kupeczky having lived for many years in Rome and finally settled in Nuremberg, which at the time was the city of art and culture; whilst Adam Mányoky, who lived for many years and studied art in Hanover, Paris, and Holland, became the favourite painter of the King of Poland, Frederic Augustus II., also Elector of Saxony.

Both these artists cultivated the art of portrait painting, and followed the style and tendency of the Rembrandt and Vandyck schools, of which they were most able exponents. It may be of interest to know that both of these painters are represented in the gallery of the Marquis of Bath and likewise in the leading collections of Europe.

The frescoes of the Budapest University Church date from the eighteenth century, and although they have been hardly dealt with by time, nevertheless they may be regarded as fine specimens of the rococo style.

During the reign of the famous Queen Maria Theresa (1740-1780) art and science received great support and encouragement, and this was partly the case during the rule of her son, Joseph II. (1780-1790), but unfortunately the kings that followed them have shown no desire, nor did they have any inclination, to encourage Hungarian art, science, and literature; besides their time had been otherwise taken up with continual wars, which was especially the case with Francis I. (1792-1835).

Under such conditions art again lay dormant, and the few who made it their profession could barely make a living, and some of the most celebrated portrait painters had to take to painting sign boards, or to adorn with pictures the household furniture of the peasants, while the sculptors had to work in the potteries. In the Koronaherczeg - street of Budapest, there is a signboard which was painted by one of the most famous Hungarian artists, Barabás.

Towards the middle of the last century that great Hungarian patriot, Count Stephen Széchényi, to whom Hungary owes so much for its resuscitation in many directions, had also seriously occupied himself with the promotion of the arts, and his activity in this direction was followed up with the greatest zeal and energy by the late Minister of Education, H. Auguste Trefort. With a view of attaining his object, the late lamented Minister founded an Art Union, which had for its object the exhibition from time to time of pictures presented by Hungarian and foreign artists, which were disposed of by means of a lottery amongst its members.

The stormy period of 1848 and the sad days which followed put an end again for some time to the development of Hungary in general, and with it its arts and industries suffered; as soon, however, as peace was restored in the country, and by the Treaty of 1866 Hungary had a free hand in the management of its affairs, the people settled down to work, and art and science commenced to prosper once more.

In the year 1870 the first school of Fine Arts was opened under the direction of the famous painter Gustavus Keleti, and later the school of painting began its activity under that illustrious painter Julius Benczur.

The Government took the matter seriously in hand. A Fine Art society and other institutions were formed under their auspices, scholarships were granted to deserving art students, and in many cases the entire expense of their education was defrayed both at home and abroad by the Government. The result of this was that the country became possessed of some of the foremost artists in Europe, men whose names will be handed down to posterity.

Charles Lotz and Maurice Than.—Few nations indeed can boast of artists who rival Maurice Than and Charles Lotz. The gigantic ceiling painting of Lotz in the Budapest Opera House will for all times be the wonder and admiration of those who are privileged to set eyes upon this marvellous work of art, and the frescoes in the great vestibule of the central railway station at Budapest painted by Than are works of no less merit.

Professor Julius Benczur and Székely.—The historical painting by Julius Benczur representing the baptism of St. Stephen, and

the famous picture of Bartholomew Székely depicting the finding of the body of King Louis II. after the battle of Mohács, will be monuments of true artistic value for all times. To the same school as the former also belong, the painters Alexander Wagner and Alexander Lietzenmayer.

The late Count Zichy.—Another Hungarian artist of universal fame was the late Michael Zichy who, by wonderful and life-like subjects, familiarised the world with the great beauty and charm of the national ballads of that immortal Hungarian poet, John Arany.

Michael Munkácsy.—And who does not know and honour the name of Michael Munkácsy who, by the aid of Professor Szamosi, and the landscape painter, Ligeti, rose from the position of a carpenter's apprentice to the rank of the greatest of living artists. His large pictures of "Christ before Pilate," "Golgotha," and "Ecce Homo," have been exhibited and admired in London, whilst his numerous national pictures and other subjects have all attained universal fame. His pictures of Hungarian types and scenery which have brought to life some of the first poems written by Petofi, the greatest of Hungarian poets, will live for ever in the history of Hungarian art. Munkácsy, prior to being a painter, worked as a carpenter in the town of Nagy Várad, where M. Szamosi, professor of painting at the college, discovered his talent and gave him his first lessons in art. It was my privilege to be a student of this professor many years afterwards, and this led to an intimate friendship between myself and the great painter in later years. I have seen many of his original drawings there, and a tailor of the town got one of his sketches for a pair of trousers, whilst my barber had his sign board painted by this future famous artist for 3s. 6d.

Árpád Festzi.—Árpád Festzi is another artist of great fame, and his picture "Mary and Magdalen at the Grave of Christ" and his frescoes in the Palace of Justice, as well as his collosal panorama representing "The entry of the Hungarians under Árpád," are all triumphs; the last-named picture was exhibited some years ago in London.

Genre Subjects.—*Genre* subjects are represented by numerous distinguished Hungarian painters. The religious pictures of Roskovics are as famed as the portraits of Vastagh, Horowicz, Balló, Parlaghy, Karlovsky, Bruck-Lajos, Fülep László, &c.

The two last named are well known in this country, and those who may have the opportunity of visiting the exhibition of Fülep László's works in June next, at the Fine Art Society, in Bond-street, will be convinced of the great merits of this Hungarian portrait painter.

Unfortunately time will not permit me even to enumerate the host of distinguished artists in all branches that Hungary can boast of. I should, however, be doing an injustice to them were I not at least to mention their names in a casual way. They include Bihari, distinguished for gipsy and national life; Vágó, popular subjects; Margittay, humorous and modern social life; Lajos Ebner, and Jankó, famed for their *genre* subjects; Markó, celebrated for his landscapes; Telepy, mountain scenery; Ligeti Eisenhut and Tornai, for their Oriental subjects.

A large collection of paintings by Tornai, representing life in India, China, &c., will shortly be seen at the Goupil Gallery, Regent-street.

Plastic Art.—In the plastic art and sculpture, Hungary can claim to rank amongst the first countries in Europe; indeed, few nations can boast of so many famous sculptors as Hungary.

Stephen Ferenczy.—Stephen Ferenczy, in the year 1840, was the first to pave the way. Then came Joseph Engel, whose mythological and *genre* style showed great merit. The monument of Szechenyi, by this artist, which was erected in the year 1880, in front of the Academy of Science, is a wonderful artistic work. Nicholas Izsó is rightly famed for national subjects, and his monument of the poet, Michael Csokonai Vitéz, in Dereczen, is a masterpiece. The beautiful statues along the Danube quay, at Budapest, of Baron Eötvös, and the statue of the great Hungarian poet, Petöfi, by the sculptor Huszar, are admired by all who visit the Hungarian capital.

Alois Strobl and George Zala, are each deservedly famed, the first as the wonderful creator of that lovely monument representing the poet Arany, whilst Zala distinguished himself in the monument representing the Arad Martyrs, and the recently unveiled statue of the late Count Julius Andrássy.

Fadrusi will rank for all time as one of the best sculptors, and his monuments of Maria Theresa and King Matthias will always be works of the highest merit.

Architecture.—Hungary boasts of a great number of highly-talented architects, and it is

owing to them that the public buildings of the city of Budapest are considered among the finest in Europe.

Nicholas Ybl was the first to distinguish himself with his beautiful designs of the Royal Opera House, the Customs House, and the Bazaar of the fortress of Buda. Nothing can excel in style and beauty the Houses of Parliament which were recently erected along the Danube quay, at a cost of nearly £3,000,000, after the designs of the architect, Emerich Steindel. The beautiful Gothic structure is a real triumph of art, and it is a worthy rival of the Palace of Westminster, which inspired the great artist.

The imposing new buildings of the Palace of Justice, close by, which were recently erected at enormous expense after the designs of Alois Hauszmann: likewise the new Palace of Buda, commenced by Ybl, and completed by Hauszman, may be regarded as the pride of Hungarian architecture.

Altogether Budapest may be termed a city of art. There are two beautiful palaces of fine arts and a National picture gallery filled with the most precious treasures that money could purchase at home and abroad.

In addition to this there are numerous private collections both in Budapest and in the country. There is a museum of Fine Arts which will bear comparison with any of its kind, and everything is done both by the King and the Government to encourage native artists and to induce them to live at home, for the good of the country. It is fortunate that the country possesses such a gifted and esteemed nobleman as Count Albert Apponyi as its Minister of Arts and Culture. Doubtless under his able direction the arts of the country will flourish more than ever.

Hungarian Industries.

I will now briefly refer to some of the industries of Hungary. It must be borne in mind from the outset that in a country like Hungary, where about 70 per cent. of the population are engaged in agricultural pursuits, not much can be expected in the matter of industrial activity, yet the country can boast of some very important industries.

Thus the goldsmiths' and silversmiths' art is a very old one, and the country has been famed for centuries for its beautiful enamelled work and jewellery.

The Goldsmiths' and Silversmiths' Art.—A collection of ancient Hungarian jewellery, comprising sabres covered with precious stones, together with other ornaments, and ecclesiastical objects collected from the different churches, was exhibited at the late Paris Exhibition, where it created the greatest interest, its value being some millions of pounds.

The Hungarians, being of Asiatic descent, are rather fond of wearing articles of finery, which in this country are confined to the fair sex. The poorest peasant will have a double row of gold or silver buttons on his Sunday attire. The picturesque Hungarian costumes lend themselves very much to ornamentation, and, as must be remembered, the military hussar uniform in the armies of the world is practically copied from the costume worn to the present day by the peasantry throughout Hungary. Of course, the costume varies according to the means of the wearer, and naturally on fête days it is of a more elaborate kind. The gala uniforms of the nobles and gentry are literally covered with the most precious stones, and very often a costume of the kind represents a fortune, and is handed down as an heirloom.

On the occasion of the visit of His Majesty the King, whilst Prince of Wales, to Hungary, His Majesty was greatly taken with these uniforms, and fully made up his mind to purchase several of them and bring them home to England, but much to his surprise he was told that the cost of a single uniform alone with all its ornamentations would come to thousands of pounds. In olden days the Magyars when in the battlefield would attire themselves in their gala dress covered with precious jewels; even the saddles of their horses would be studded with rubies, emeralds, and diamonds, and during their repeated incursions into Germany the Teutons quite enriched themselves by the capture of a few Hungarian warriors or their horses, for the safety of which they fought with fanatic bravery, as nothing is so dear to a Hungarian as his horse.

Metal and Iron.—The metal and iron industry is a very old one in Hungary. Some of the gates and ironwork to be seen in different parts of the country, dating back to the fourteenth and fifteenth centuries, are wonderful specimens of artistic skill. The enormous gate of the church of Pozsony is the finest example of the kind.

Earthenware and Pottery.—These are two very old industries in Hungary, and there is hardly a village in which pottery is not manufactured. The articles are generally made by the peasantry and are ornamented with simple

patterns depicting the daily life and surroundings of these primitive folk. Recently means have been taken to raise these industries to a higher artistic level, and the majolica manufactured by the famous Zsolnay, and also that known under the name of Herend, have found their way into the best households throughout the world, and are admired for their original and artistic designs.

It is noteworthy that no efforts have been made to deviate from the old pattern; on the contrary the articles mostly in demand are those which are faithful copies of the peasant household objects such as the *Kulacs* (water pots) and quaint *Korsó* or water bucket and their like.

Leather-work.—In this industry the Hungarians excel, and the number of articles made of leather in daily use by the peasants is marvellous in their beauty and variety of colour. The leather bag which carelessly hangs down over the shoulder of the peasant dandy when going to market; the tobacco pouch with its long fringes which hangs from his waist; the whip which he holds in his hand, or the smart and ornamented top boots which he wears, are all perfect specimens of workmanship and skill. In a variety of household articles leather and skin play an important part, and the Kulacs and other objects will generally be covered with skin neatly embroidered and stitched.

Besides saddlery and harness a very great industry in leather is the manufacture of the "Bunda." This is a long cloak made of white sheepskin, dressed with the wool inside, while the outside leather, white as snow, is embroidered generally in red and green, the national colours. The "Bunda" is worn throughout Lower Hungary by men and women alike, and is as useful as it is ornamental. For the shepherd it forms his cosy corner in the wide open plains when he cannot find a hut or a cot to shelter him. For many years I wondered why these cloaks were not imported into England, and I am pleased to say that of late I have seen here several lady's garments made after the pattern of the "Bunda." The Ködmöny is made of a similar material, but should be tight fitting.

The "Szür," made of a kind of homespun wool, richly ornamented with embroidery, is an article for which there is a great demand; whilst the "Guba" is the winter garment, of long rough wool, which the swineherds, shepherds, and others, who cannot afford the leather "Bunda," wear in certain parts.

The furrier's trade is also a very old one in Hungary, and it is noticeable that some of the largest furriers in London are Hungarians.

But the most popular industries in the country are those known under the name of home industries. These include weaving, linen, embroidery, needlework, lace, basket weaving, and the making of a number of household articles, for which the Hungarian peasants have been famed from time immemorial.

The beautiful workmanship of table covers and centres, and the exquisite taste shown in the stitchery and patterns of the lace work could not be outrivalled. The most celebrated embroideries are mostly known under the name of "Kalotaszeg Varottas," which come from Transylvania.

The "Katrincza" on the pinafores made and worn by the peasantry in the southern part of Hungary, is admired even when worn by the greatest ladies in the land. The "Tyillim," or little carpets made by the Servian peasantry inhabiting the district of Banat, are most beautifully worked, and the combinations of colour and execution make them eligible to adorn the drawing-room of the richest, the designs of all these articles of home industries having been adhered to for centuries.

In olden days the peasants only made those objects for their own use, and would not be induced on any account to part with them, but on the initiative taken by the late lamented Empress-Queen, and the members of the royal family, including the Archduchess Isabella, and by the support of some of the leading members of the aristocracy, these home industries were developed, and the results are now to be found and admired throughout the world. I am proud to say that I can claim the honour of having introduced these Hungarian industries into this country by the generous support of H.R.H. the Princess of Wales and several members of the English royal family.

The Government in Hungary is doing everything to encourage the home and art industries, and has established numerous industrial schools throughout the land where the pupils are taught by distinguished trained professors in all arts and handicrafts. Prizes are offered for original designs which are afterwards manifolded and published with the necessary instructions in costly monthly volumes and distributed throughout the land.

In this respect our art industries owe a great deal to the indefatigable efforts of the Secretary of State, Mr. Joseph Sterényi, who has risen to his present position by hard and

honest work for the cause which he has so warmly advocated.

The Hungarian Arts and Crafts Society is another national institution under the able direction of M. Jenö de Radisics, which has contributed so much to preserve and encourage the artistic trade in Hungary. In the spacious museum are exhibited some of the rarest specimens of ancient and modern national workmanship in all branches, such as furniture, jewellery, embroideries, and other decorative works of art, and in addition large amounts are expended annually in the purchase of foreign articles of arts and crafts which have gained rewards or are otherwise noteworthy.

Flour Mills.—In connection with the more important industries associated with agriculture, there should be mentioned the world-renowned steam flour mills, which up to now cannot be surpassed in any country, and, thanks to the good quality of Hungarian wheat and to the mills, Hungarian flour is preferred to any other in the world.

Distilleries.—Another industry in which Hungary is great is spirit distillation. You find stills in almost every village, and the Hungarian peasant's national drink, *Pálinka*, a kind of spirit made of rye and barley, is a splendid substitute for Scotch whiskey.

Sugar.—The sugar factories and refineries are most important, and form leading industries of the country; in addition to which there are factories of tobacco, petroleum refineries, with numerous chemical and other works throughout the kingdom.

Hungary, however, admits that it is by no means an industrial country, and though there are a number of cloth weaving mills there is a great want of textile industries. The country which produces sufficient raw wool not only for the manufacture of articles for home use, but to supply also the foreign market, yet has not its own factories, and now exports the raw material only to buy it back at a heavy increase made up into fabrics. The yearly importation of textile articles alone is remarkable, amounting to over 375 million kronen, most of which is imported from Austria. The Hungarian Government is endeavouring to establish factories at home to supply the demand, and is desirous of granting special privileges and monetary assistance to manufacturers.

The people of Hungary are somehow not enterprising enough or have not the necessary capital at their command, and though the Government is doing all in its power to foster the textile industry, the progress made in this direction is somewhat slow, and there is an excellent opportunity for English capitalists to extend their business in Hungary; the experiment would prove most remunerative in every respect. There is all the more reason for this as the Hungarians, who have always from time immemorial been admirers of the English race, give preference to any articles manufactured in England. Even now a large amount of British wool stuffs is bought in Hungary, but of course the Protection tariff of the dual monarchy handicaps very seriously importation on a large scale.

Those English firms who some years ago founded branches in Hungary for the manufacture of agricultural implements have had no reason to regret their action, and English people would do well to take advantage of the opportune moment before they are ousted by Germany.

In Hungary, foreign invested capital is guaranteed by the laws of the country, and when it is added that such an eminent person as Francis Kossuth—who, by his education, might almost be regarded as an Englishman—is at present the Minister of Commerce, it is evident that now is the proper moment to take a decision in this direction.

DISCUSSION.

The CHAIRMAN, in opening the discussion, was sure all had followed the paper with the greatest pleasure and interest. The author's mention of the Magnate dresses had reminded him of an occasion on which a large number of foreigners, including Englishmen, were received in Hungary by the Minister of Commerce, who appeared in a dress like that worn by the Earl of Leicester at the Court of Queen Elizabeth. It was of scarlet satin, slashed and embroidered with gold; and he remembered that when the minister appeared on the platform to address the assembly, he could not help saying to one of his neighbours "Where is Queen Elizabeth?" Those present who happened to be in Budapest eleven years ago must have followed the paper with particular interest, because at the Millennial Exhibition which was then held the whole of the treasures of Hungary in architecture, art, and industry were spread out before their eyes. Some might wonder how it was that the treasures of architecture could be seen, but the author had given a hint on that subject. There were produced at the Exhibition in the most marvellous manner the chateaux, the churches, and the town halls of Hungary, and the closest inspection would have left

one still in doubt as to whether the buildings were the real thing or not. Although the buildings were only reproductions, they were filled with all the real treasures gathered from the churches and private houses of Hungary; and although Mr. Felberman said that most of the treasures of the country were destroyed, the remnants were sufficient to fill the splendid palaces in question. Ancient art silverwork was to be seen, and sculpture, enamels, illuminated books, croziers, crosses, monstrances, and chalices, all in the most splendid preservation. He thought the Hungarians must have been very great in silver, ivory, and woodwork. Family portraits, ancient paintings, china, most beautiful glass, armour, weapons, hunting horns, drinking horns, which were really architectural monuments, they were so big and so elaborate, were also to be seen. He did not know what the drinking capacity of the Hungarians in olden days must have been, for the drinking-horns were simply enormous. Lastly, many specimens of furniture were on view. Side by side with those treasures were to be seen the embroideries, and the other products of native industries which the author had described, displayed in modern buildings, which also were very beautiful and picturesque. He bought some of the embroideries in the belief that such things were not to be obtained in England, but was disappointed to find a few months afterwards similar goods in immense quantities in a shop in St. Paul's Churchyard, which showed how very quickly things of that sort were discovered by English tradespeople. Budapest, as a city, could be likened to Edinburgh. If Prince's-street could be imagined, with palaces all along the front, the Emperors' Palace on the opposite height, with the old Castle of Buda, and running between, not the lines of the North British Railway Company, but the splendid Danube, flowing at the rate of six knots an hour, they would have a very good idea of what Budapest was like. Strolling along the streets of Budapest, the very best of everything was to be seen in the shops, while along the streets were electric trams of the latest design. There were curious little stations for the underground electric railway, which he thought were an example which might be followed everywhere. Instead of the ugly structures to which we were accustomed, the entrances to the underground railway stations in Budapest were most airy and beautiful, modelled apparently on the companion ways leading down to the saloon of a big steamer, made of majolica ware, and kept thoroughly clean by being well syringed every morning. An exhibition of the works of the great painter Munkacsy was also to be seen, and if the visitor strolled along the quays he came to that palace of Parliament which Mr. Felberman had so graphically described. He personally regarded that palace as the finest example of modern architecture to be seen in Europe. There was in the building an extraordinary combination of one style with another, a combination of a dome with what English people would call early English, with pointed arches and lancet windows, an entirely harmonious effect being obtained. If some of the audience could only see that building he was sure they would desire that similar buildings should be built in this country. He was a little enthusiastic about Hungary, but he was perfectly certain that anyone who visited that country would also become enthusiastic.

Mr. R. J. Mackay said it was one of the greatest pleasures of his life to look back on the happy weeks he spent in Budapest, especially to the Millennial Exhibition, which the Chairman had so graphically described. The Library of Matthias Corvinus which was there exhibited, and which consisted of a complete collection of the arts and literature of the time, was a particular source of interest to him. Matthias Corvinus was one of the greatest leaders of all times, and a wonderful man in every way. He advised any of the audience who had not been to Hungary to go there, because he was convinced they would return with the same delightful experiences as all the visitors who went to that interesting country.

Mr. Adam Scott had been particularly interested in the author's statement that the churches in Hungary in olden times were built so far away from the towns, because it threw a light on a puzzling question. An old German medal of the seventeenth century was brought to him, which had been struck in commemoration of the Jubilee of the building of an Evangelical Church in a German town. On one side there was a representation of a church, with the words, "Ach wie nahe" at the top. On the other side there were a few houses representing a town; on the corners were two fortified churches on hills, with paths leading from the town to the churches, and people going along them; and on the top were the words, "Ach wie weit." The medal was in the possession of the British Museum.

On the motion of the Chairman, a hearty vote of thanks was accorded to Mr. Felberman for his interesting paper, which Mr. Felberman briefly acknowledged, and the meeting terminated.

THE PRESENT STATE OF PHOTOGRAPHY.

By Chapman Jones.

In looking back at the course of the development of photography, it is interesting to compare the progress of the art, that is its application in picture or record making, with the progress of the science, that is the study of its underlying principles, and the influence of each upon the other. It is not putting the case too strongly to say that photography has generally been regarded by men of science as too insignificant a

matter for their serious attention. With a very few notable exceptions they did no more than make a casual suggestion now and again, treating it in short as a menial servant or else disregarding it altogether. The natural result is that photography was worked out empirically by those who were unable to bring anything more than the most superficial knowledge of general principles to their aid.

Silver salts were used because some of them were known to darken by exposure to light. Iodine was used because it was known to change the colour of the surface of metal plates. And so by feeling about with these things—one might almost say fooling about, but that it would be disrespectful to the early workers to whom we owe more than we can ever tell—by feeling about with these things there was evolved a photography, the full character of which the discoverers themselves had no idea of.

And we may well ask how much further have we advanced than they did? Fundamentally, not at all. We have only perfected their methods. We still use nothing but silver salts, except perhaps as mere adjuncts, for camera work, and no other metal has been shown able to replace the silver. Of course, silver may be exceptional in this, but it seems that it would be more in accordance with general facts if this property were shared by a great many metals, if not all metals, in various degrees. Silver may stand at the head of such a list, and the fact that it is the best known conductor of heat and electricity may have something to do with it. But whether silver is one of many or one alone, it appears to have been an exceedingly fortunate circumstance that it was the metal worked with from the earliest days of photography.

The same clinging to mere empiricism, or the practice of the art without regard to the principles it is based upon, is shown in the treatment of negatives during and after their development. General practice, and the procedure recommended on what is often called "high authority," is too often based on the sands of assumption instead of the rock of fact. Like jerry builders and those who patronise them, appearance is the only criterion of success. The "clearness" of a negative is judged of only by its appearance, so that instead of being clean it may be full of substances ready to produce visible stains by circumstances that can hardly be avoided, and that are without doubt uncertain. Intensification results are judged of merely by the appearance of the negative and perhaps of the print it gives. The gradation may be falsified or it may be improved, but it is all haphazard, the resulting image may be such that it changes from week to week, but so long as the intensified negative looks nice when it is done, the method used is recommended as excellent.

These natural and perhaps inevitable results of the empirical study of the art rather than attention to the science of photography, might be multiplied again and again, for even notable investigations have been made with the sole aim of finding an exact method of determining certain properties of plates that have no definite quantitative existence, but depend entirely upon circumstances, and so far as practical work goes, on very variable circumstances.

But there is something to be said on the other side. There have been almost all along a few enthusiastic if little-appreciated workers, and at the present time there are many more. The chemical constitution of developers has been elucidated, so that it is generally possible to tell whether a substance will or will not serve as a developer before it is actually put to the test. The result of this is that, instead of being limited to one or two developers, the character of organic developing substances has been generalised, and there are so many known that will serve that the difficulty is rather to select the most suitable. As would be expected, they are not all alike in their action. They differ in their manner of development, and, what is less often recognised, in the character of the substances that they are changed into by the process of development or oxidation. The residual products should, of course, be readily soluble in the liquid employed, so that they may be easily removed.

We know a little of the chemistry of some of the more common changes that take place during the making and treatment of negatives, though the knowledge is rarely taken advantage of. A great deal of good fundamental work has been done with regard to colour, its effects and its reproduction, but even here there is now a tendency for the art to overwhelm the science, and for the practice to become merely empirical.

Perhaps the most obvious and immediate need is the bringing together of the experiences of the everyday worker and the investigations and speculations of the investigators. Some researches bear on the very face of them the indisputable evidence that their authors are not practical photographers. It is doubtless, partly due to the fact that so few persons who possess the practical knowledge and skill which make a good photographer, have also the necessary acquaintance with scientific facts and methods of exact investigation coupled with the desire to help forward our knowledge of the subject, that the scientific side of photography receives such scant attention from the practical workers. But the shallow empiricism that looks only to the immediate and superficial result is still the chief guide, not only of those who have been taught by experience to rely upon it, but of others who merely follow the fashion.

THE BRITISH INDIAN COMMERCIAL MISSION TO SOUTH-EASTERN PERSIA.

III.

Russian Competition.

The competition of the State-assisted Russian trader with the British and British-Indian trader is serious. The Russian Government has for years been

working at the Persian problem in its own way and one of its axioms is the absolute identity of trade and politics. It has taken special steps to encourage the importation of manufactures into Persia, and Russian trade has all the advantages that result from every form of State aid. According to the ideas worked to their utmost capacity by Count de Witte, it is subsidised in a way that astonishes all the world. he raw produce for the mills and factories, the very food stuff for the operatives, but not for the mere peasant or townsman, are admitted into Russia from certain regions at specially low rates, while a formidable Customs tariff is opposed to the importation of any competing manufactures. Russian-made goods are granted special rates over Government railways and for carriage by Russian ships, whose owners receive heavy bounties. In addition to this, the Russian manufacturer, when he is not exporting to a free trade country, is granted rebates equivalent to the Customs dues he has to pay. The Russian State bank assists, at rates impossible to an ordinary mercantile bank, Persian traders exporting merchandise into or buying goods from Russia.

The part of Persia contiguous to Russia is much richer naturally, and much more developed than the south; it is more thickly inhabited, the people are more advanced, the trade routes are shorter and in every way better than those of the south. Lines of railways run down to and touch the Persian frontier, connecting the caravan routes with the Russian manufacturing centres. Now we are to have a motor car service for the carriage of merchandise running into Persia from Russia; her roads are made; a concession has been granted; the scheme is near completion. There are no breaks in the telegraph, nor any paucity of lines, so depleted markets can thus be quickly replenished from the northern centres of Russia under three months from date of ordering, whereas it takes an Indian or English merchant from at least six to eight months to do the same, a serious consideration, as it not only means capital locked up for twice the period, but very often loss of market.

In addition to the various subsidies given to manufacturers in Russia, and the special rates accorded to their goods over the State railways to the frontier stations, there are a number of ways in which the Russian Government and the Russian Bank assist not only the Russian merchants but their Persian customers as well. Moreover, in the north and south alike, Russian consuls are as active as any merchant in pushing the interests of Russian trade, and the introduction into South-Eastern Persia, by the Russians, of methods of trade finance that have hurt us seriously in the west and north cannot but be viewed with uneasiness. Unless the British and Indian Governments see fit, as already stated, to do something for the fostering of our trade in Persia, British interests may suffer in the future even more than they have done in the past.

The Russian Steam Navigation Company, trading from Odessa to the Gulf ports is given an annual subsidy, for the carrying of bounty-fed goods, which comes to £4,000 per trip. The Suez Canal dues are also refunded. Thus the Russian shipper gets an advantage which ought to enable him to put his goods on the market at rates by which he could outbid all competitors. Nevertheless, he is not quite able to do so, though he has succeeded extremely well, especially in the northern provinces, in pushing sugar and certain lines of cotton prints and Turkey reds, which latter the Persians seem to think are of better quality than English goods of the same character. The Russian manufacturer, like the German, is willing to execute small orders and to make new patterns if asked to. He foresees new demands to meet them; in a word, he does not force what he has down the throats of his customers, but supplies what is wanted.

Matters Consular.

Mr. Gleadowe-Newcomen is of opinion that the time has come when we should make diligent efforts to maintain our supremacy in South-Eastern Persia. He compares at length the consular arrangements as pursued in Persia under the Foreign Office with those under the Indian Government, to the marked disadvantage of the former, and suggests the advisability of making a Consul-Generalship for Kerman and Persian Baluchistan, bringing Yezd (with a Vice-Consul of its own) under its jurisdiction, as well as Bander Abbas, in all matters commercial. The appointment of Vice-Consuls at Yezd and Bam, with consular agents at Sirjan, Rafsinjan and Bampur is also recommended, as well as a Commercial Attaché at Teheran. Many other detailed recommendations on a variety of points are made, which undoubtedly require careful consideration, but want of space precludes notice of them here. The following points for increasing in Persia the knowledge of India and her manufactures are advocated, viz.:—

(1). At every consulate or consular agency a showroom to be set apart for samples of Indian goods with prices and full details clearly marked in Persian, shewing place of origin and from whom obtainable.

(2). Consular officers to be provided by the Indian Government with funds and with collections of articles intended to be offered as gifts to Persian gentlemen and their servants who have shown themselves friendly to the British Indian cause. These form the *Toshakhana*.

(3). The touring of India by Persian boys, who have been sent there to be educated (as mentioned above).

(4). The encouragement of Persian merchants to visit Indian trade centres by the granting of assisted passages to and fro.

Communications, Roads, Posts, and Telegraphs.

Of the three prime wants of Persia, not the least is the improvement of communications. Practically there are neither waterways nor roads, with the exception of three short stretches in the north—Resht-

Teheran, Teheran-Meshed, and Ashkabad-Meshed—where rough waggons are now, and motors will in the future be used. Camels, mules, and donkeys are still, in the twentieth, as they were in the second century, the carriers of of Persian commerce. The great caravan routes urgently require improvement, though, of course, a network of good roads, after the fashion of Europe, America, or even India, can hardly be expected soon from a thin and widely scattered population of ten millions, whose annual consumption of imported articles amounts to only Rs. 7½ per head. But as to mere improvement of tracks, Kafilas have for ages worked their toilsome way along river beds and valleys, over mountain passes and along certain tracks across the plains. In time a faint and indistinct groove has been worn in the ground, and at night the silent camels find their way across the desert by scenting the odour left by those preceding them. With the worst parts of the inland roads made easy, the costliness of transport alike in time and money would be reduced.

It is a different thing when one comes to the consideration of the tracks connecting the coast towns and ports with the towns on the plateau. The only epithet that can be applied to these tracks, whether from Bander Abbas or Bushire, is "terrible." Hence the assistance of the road builder is essential. By shipping goods to Bander Abbas and Mohammerah and thence inland, a considerable saving would accrue, provided proper roads were available, and wheeled traffic could run. Goods for the interior are sometimes delayed for months, waiting for pack animals or until a sufficient number can be collected to form a large caravan and thus ensure immunity from attack and robbery. And, lastly, the lack of a properly organised system of transport causes delays, especially at Bushire and in a lesser degree at Bander Abbas. Mr. Gleadowe-Newcomen is of opinion that money spent in improving the port and its communications will be a profitable investment, both to Persia and to India. He advises that the Government of India apply at once for a concession to construct a road to Kerman in Minab, Rigan and Bam, the road to be built on a proper level for wheeled traffic. This would not only facilitate and expedite trade, but open up a large tract of country for the growth and exportation of cotton, gums, &c., by bringing it in touch with Bander Abbas. Later on, extensions might be made up to Teheran, Seistan and Khorasan, and once the road was made it would be found feasible to run motors or some other description of traction cars for the carriage of merchandise. The exploitation of the mineral resources of the country, and the erection of mills and factories, would thus be rendered possible by the opening up of good road and wheeled traction.

If it be desired to develop the Quetta-Nushki route to its utmost capacity, the railway should be continued to Kala Robat, on the confines of British territory. This would mean that the time occupied on the journey to Seistan would be very greatly reduced, while the land trade of India with Persia would receive a very great impetus. The whole of Persian Baluchistan would be commanded, and Bam would then be only about 150 miles and Nasratabad about 90 miles distant from a British railway terminus. The line could be laid along the existing caravan road.

At certain seasons of the year in certain localities, though their operations are not confined to those places, the highways of Persia are infested with brigands. These men are seldom particularly bold or enterprising in their work. Large and well-armed caravans or armed Europeans have little to fear. Travellers moving singly or in small companies, together with the Persian post, when there is reason to believe that it carries valuables, are constantly being looted in the spring and autumn, which are the times when the Nomads are generally on the move. There is no difficulty in explaining or accounting for the insecurity of roads, speaking generally. Every year the Government of the Shah apportions large sums of money for the establishment and equipment of guards to secure the safety of the roads. Almost the whole of this money is embezzled by the Persian officials, little indeed reaching the hands of the road-guards, who are forced, in order to live, to emulate the lawlessness of the freebooters they are supposed to restrain. The story is an old one in Persia. It was the unpaid road-agents who long ago showed the Mongols and Turkoman hordes the way over the deserts and through the mountains where, had the officials of the Shah been passably honest, the former must have perished.

The Imperial Government is, however, bethinking of responding to the pressure brought to bear on it, and devising some means of redressing the abuse. Mr. Gleadowe-Newcomen suggests the establishment of a *gendarmerie*, officered by British, for the southern provinces, after the fashion of the Persian Cossack Brigade, which was raised in the northern provinces, officered by Russians, and brought to a very high pitch of efficiency. An alternative system would be to pay the Nomad chiefs a subsidy, and make them responsible, under heavy penalties, for guarding the special roads within their district.

The postal service in Persia has undoubtedly improved in certain sections, since it has been taken over by the Belgian administration. Most of the towns now enjoy a weekly post, whilst the chief cities have a bi-weekly service. A parcel-post service between Persia and Europe *viâ* Russia exists, but this is not very satisfactory, as all parcels are opened at the Russo-Persian frontier, and losses through robbery are frequent. Matters would be improved if there were a European agent on the frontier to look after the taxing and forwarding of the parcel post. At present there is no through foreign parcel post from the Gulf ports to the interior, a most unsatisfactory state of things The postal rates too for local parcels are extremely high. The Belgians are trying to bring about still further improvements in the service, and these are bearing fruit. Further

improvement is, however, still possible, *e.g.*, between Kerman and Bunder Abbas, where the distance might be covered in less than a week, *i.e.*, less than half what it takes at present. Why Bam should not be linked up with Seistan, to the great benefit of India, whose postal service would thus be joined to that of Eastern Persia, it is difficult to understand.

Telegraphic communications have been greatly improved and extended of late years. In addition to the main Indo-European line from Teheran to Bushire, a second three-wire line, known as the Central Persian line, has been constructed. It branches off from the former at Kashan and runs, *viâ* Yezd, Kerman and Bam, to Kala Robat, on the British-Perso-Afghan frontier, all the important towns, *en route*, being connected. Robat has been connected with Nushki and the Indian system, since the MacMahon Mission. It is further intended to establish a more southern land connection by way of Rigan, Bampur and Kuhak, to meet the line which will be constructed from Karachi and for which a survey has been already made on the Indian side, *viâ* Panjgur and Kolwan.

There are various minor links mentioned in the present Report, one of the most important being the opening of a telegraph office at Bander Abbas. This suggested reform it is believed is now being carried out. A detailed notice of the various recommendations in regard to the telegraphic network, important though they are, is beyond the limits and scope of this summary.

ENGINEERING.

The future prospect of Persia is to a great extent in the hands of the engineer, who will build the road and irrigation works that are so urgently needed and exploit her mineral resources.

Irrigation.—Given a sufficient supply of water, Persia, much of which possesses as perfect a climate as could be desired, and a soil which is naturally fertile, would be a garden. The problem is now to get the water, for at present the arid zone is spreading and every year sees an addition to the dreary numbers of ruined and abandoned villages and *kanats*. The construction of the underground canals is very slow, primitive and liable to accidents; there is only one advantage and that is, that the water flowing in deep covered channels is less liable to evaporation. The rainfall of Persia is not great, it may perhaps reach eight inches a year in the south-east and twelve to fourteen in the south-west. What rain does fall, except in the form of snow, runs off the hills at once, for they are generally bare of trees, vegetation or soil, and runs to waste. No efforts have been made for centuries to build reservoirs or dams or to ensure in any way the snow or storm-water, though there are scores of places in the mountainous land where sites for dams and reservoirs could be found.

Railways.—As to this Mr. Gleadowe-Newcomen's opinion, is that it would not be difficult to construct a railway from Bander Abbas to Bam. But it would not pay to build any line in Persia unless the production, population and trade of the country were at least doubled. According to the plan sketched out by the Russians there are three contemplated schemes, one from Baku to Teheran, viâ Kisht; one from Julfa on the Trans-Caucasian border viâ Tabriz, Teheran, and thence through Kashan, Ispahan, and Shiraz to Bushire on the Gulf; and the third taking off from the Russian Trans-Caspian Railway, near or at Ashkabad viâ Meshed and Seistan, through Persian Baluchistan to the Gulf, touching the sea at Minab or Bander Abbas.

These projects are (as regards two of them, at least) so plainly inimical to British interests that it is difficult to regard them as within the range of practical politics.

Harbour Construction.—Bander Abbas is superior to Bushire, alike as a port and gate of entry into south-east and Central Persia, but improvement is needed by dredging operations and the building of a good pier and a breakwater, the latter to ward off the formidable surf when the wind is strong from the south-east. The port of Bushire, where ships anchor in the open roadstead between three and seven miles from the Customs wharf, could also be improved at a small cost.

Mining.—The contorted strata of the mountains with which Persia is seamed are certainly highly mineralised, but these mountains are very little known. In places copper, turquoises, and other minerals are being worked after methods even more crude than those of two thousand years ago. Among minerals cited by Mr. Gleadowe-Newcomen (with particulars of the localities) are asbestos, copper, lead, zinc, iron, sulphate of copper, coal and borax.

CUSTOMS.

The new tariff, both in the export and import trade of Persia, is in many ways unfair to British interests. Some of the chief Persian products taken by the British Empire are grains, linseed, sesame, and opium. In all these the new tariff has increased taxation from 3½ to 20 per cent., while exports taken almost entirely by Russia, such as rice and cotton, have been freed from taxation or nearly so. It is the same with imports. Indian tea, for instance, which formerly was taxed at 5 per cent. *ad valorem*, is now taxed from 50 to 90 per cent., while the duty on petroleum, almost purely a Russian product, has, on the other hand, been reduced from 5 per cent. *ad valorem* to 1½ per cent.

Articles produced in common by both Empires, such as piece goods for instance, pay equal duties. Yet, even so, this works to the advantage of Russia. Russian goods are more costly at the ports of entry than Indian or Manchester goods. So the substitution of a tariff of charges by weight for an *ad valorem* charge compels the importer of a ton of cheap British goods to pay the same duty as a ton of dear Russian goods, which is manifestly unfair.

As a whole Mr. Gleadowe-Newcomen declares that

the result of the introduction of the new tariff and its administration by European officials has so far been an increase of revenue, but it is open to doubt if it has helped trade generally. The new tariff, he further contends, is based on an extremely complicated system as opposed to the old simple method of taxation by value.

This ought to be changed, simplicity in such matters being essential in a country where the traders and people are centuries behind their times.

The "Règlement Légal" consists of 112 articles, and a good many of these are objectionable and threaten, as in Bushire, to bring the seaborne commerce of Persia to a standstill. The rest are either obscure and ill-defined or unworkable and unsuited to the conditions obtaining in Persia and the Gulf ports. They have been imported bodily from the Customs rules in Belgium, a small and civilised country where railways have abolished distance, and ships work alongside wharves, close to the Custom-house under the eye of the Central Administration. In Persia (to go no further than the last item) the Central Administration to which all appeals must be referred, is at Teheran, a month's journey or more from the ports.

The language in which customs notifications are printed is French, whereas Mr. Gleadowe-Newcomen contends with some force that seeing what England has done for opening up, safeguarding and developing the Persian Gulf trade, the least that can be done is to admit the use of English as well as Persian, which is understood by all traders whether natives of India or Persia.

Lastly may be mentioned the subject of the abuses of farming out the road posts and the revising of interior dues which, though absolutely illegal and even contrary to our Treaties, are still levied.

The various trading centres are then reviewed at length in the Report, each locality being taken in turn alphabetically, and its circumstances, position, trade, industries, disabilities, possible improvements, &c., being carefully described and analysed. This is succeeded by a review of all the chief articles of export and import.

RESUMÉ.

It is evident from a study of trade movements in Persia, that British commerce with that country is not in a healthy condition. It has expanded but little during the last fifteen years; it has been practically stagnant during the last four years, and the latest available statistics show a slight actual decrease. This slight decrease becomes a very great relative set back, when compared with the enormous advance made by Russian trade with Persia of late years and especially during the years 1900 to 1904.

Roughly, the value of the entire foreign trade of Persia in 1903-4 was 10⅝ million sterling, of which Russia's share was 5⅝ and England 2½ million sterling. The greater part of British and Indian trade is through the Persian Gulf ports, and the movement of trade in the Gulf, therefore, offers a very reliable rough index of the movement of British trade with Persia. Nevertheless, the position of the British trade is not so bad as might be inferred.

Trade between Russia and Persia is greatly facilitated by comparatively easy communications (including railways), between the two adjacent countries and the practical identity of the two peoples. Added to this is the fact that these northern tracts are the richest and most prosperous and that Russian trade is carefully nursed and bolstered up by artificial aids.

As matters stand, British trade with Persia is, heavily handicapped through the enormous difficulties in landing goods at the Gulf ports and securing their transit inland. Southern Persia is poor, undeveloped, and patrolled by robbers. The trade of the empire is not assisted by British, Imperial or Provincial Governments (as in Russian trade by the Russian Government), either financially or by bounties, rebates, and other artificial means. Lastly, British consuls do not always take that interest in the development of commerce that Russian consuls invariably do.

Generally speaking, there are in Persia, more especially in the south, want of roads and security, costly transport, a faulty postal service, and an incomplete telegraph service, coupled with the fact that there is virtually no law (as we understand it) in the land, custom and the Koran taking its place, and bribery and the strong hand ruling everything; these have all militated against the development of the resources and trade of Persia. There is some attempt being made to improve this state of affairs in the Kingdom of the Shah, and this should be encouraged and fostered by all concerned.

Before this can be fully achieved the following points should be noted:—

(1). While recognising that the British Government has been "over-reached" in the drawing up and imposition of the Tariff and the Règlement, they and British and Indian traders are recommended to accept the situation to a certain extent and insist on its being carried out, as well as the abolition of illegal taxes and the erection of proper warehouses, bonded and other.

An international Court of Appeal where Customs questions are concerned, ought to be appointed at the chief ports to avoid reference of every point to Teheran. The Customs tariff cannot be altered for years to come, but the "Règlement" (though it has been accepted by us), should be revised.

(2). Improvements at the ports of Bander Abbas, Bushire and Mohammerah are a necessity, together with an improvement in the system of lighterage.

(3). Modifications are necessary in the present methods of Customs-house working, and greater facilities are required by merchants.

(4). Communications require urgent attention. The Indian Government should in the south, follow the example set by Russia in the north.

(5). More determination and earnestness, and more

backbone are required in British policy, not only at Teheran but throughout Persia, which is difficult with the dual control that still exists, despite its condemnation by so many authorities.

(6). Consuls should be made to realise the importance of the trade and commerce of the British Empire, but this can hardly be hoped for without a stronger line of policy at Teheran, where a commercial attaché of experience and position would prove most useful to the Empire.

(7). Such commercial houses as desire to push trade with Persia should combine, so far as Southern Persia is concerned, and send out a common agent whose headquarters in winter and spring might be at Bander Abbas, and in summer and autumn at Kerman, depôts being opened under native sub-agents at Yezd, Bahramabad, Kerman, and Bam.

(8). The erection of suitable bonded warehouses, private or Government, at Bander Abbas, Bushire and Mohammerah, would enable stocks to be kept at these ports at a small cost and worked up-country as required. The erection of private bonded warehouses is provided for in the Règlement.

(9). At places where there are already well-established business houses, advantage might be taken of them to open up agencies, as long as it did not interfere with existing business arrangements.

(10). Lastly, it is strongly recommended that firms of standing and position in Persia should become members of some one or other of the Indian Chambers of Commerce, bodies that have done so much for the nterests of trade in India.

BIRTHS, DEATHS AND MARRIAGES.

The Registrar-General's report for 1905 shows that the decrease in the birth-rate which has been such a noticeable feature in the returns of recent years continues. The proportion was 27·2 per 1,000 of the total population of both sexes and ages, and this is the lowest rate recorded since civil registration was established. In 1876 the birth-rate attained in this country the highest point on record, namely, 36·3 per 1,000 living. Since then there has been decline, with hardly a break, the only exceptions being in 1891 and 1893 when there was slight recovery. But large as has been the diminution in the birth-rate, as a whole, the illegitimate birth-rate has decreased in larger degree. In 1870-2 as calculated on the unmarried and widowed female population, aged fifteen to forty-five years, it was 17·0 per 1,000; in 1905, it had fallen to 8·2.

If reference is made to the figures relating to international vital statistics, it will be found that whilst there has been a decrease in every European country, with the exceptions of Ireland, Austria, and Spain—the increase in Ireland being 2·30, in Austria 0·8, and in Spain 0·4—the decrease in the English birth-rate has been larger than in any other country save Belgium and France. In England, taking the 20 years 1880-82 and 1900-02, the proportion of legitimate births per 1,000 wives between the ages of 15-45 years was 17·7, in France, 19·7, and in Belgium 19·8, the decrease in the German Empire being only 8·4. But if reference is made to the Australasian colonies—no figures are given for other British colonies—it will be found that the decrease has been much more considerable even than in Belgium.

In Queensland, taking the same period, there has been a shrinkage of 23·2 per 1,000 wives, in South Australia 28·0, in New South Wales 30·6, and even in New Zealand 24·5. These are very remarkable figures, and suggest uneasy reflections. There would seem, as the Registrar-General says, to be some universal cause operating throughout civilised countries to account for the phenomenal decline in human vitality, and there is strong ground for the assumption that, in greater or lesser degree, the chief cause has been the deliberate restriction of child-bearing on the part of the people themselves. Even in countries like Australia, where one would have thought that large families would be welcomed, it seems that this influence is operating, and operating even in greater degree than in countries like England, where the means of subsistence are less easy to find.

Turning to marriages, the tables show that last year there was a slight increase as compared with the average of the ten years. The marriage-rate in 1893 was 14·7 per 1,000 living, during the next six years it steadily rose to a maximum of 16·5 in the year 1899, while from that date it fell continuously to 15·2 in the year 1904, and was, as above stated, 15·3 in the year under review. The figures show how great has been the diminution of the marriage of minors. In the years 1876-80 the number of husbands who were minors in a thousand marriages was 77·8, and of wives 217·0. In 1905 the figures were respectively 43·8 and 146·9. Since 1853, when no fewer than 304 out of every thousard men, and 439 out of every thousand women, who married signed the register by mark, the proportions of illiterate persons of both sexes have diminished almost continously, until in 1905 only 17 out of 1,000 bridegrooms, and 20 out of 1,000 brides, failed to sign their names.

The death-rate in the year under review was the lowest recorded since civil registration was established. It was 1·0 below that recorded in 1904, and was 2·0 per 1,000 below the mean rate in the ten years — 1894-1904. Infantile mortality shows a gratifying decrease, although it varies considerably in different counties, being highest in those of a suburban character, and lowest in those which are rural. The deaths of infants under one year of age were in the proportion of 128 per 1,000 births in the year under notice, as compared with 145 in the year immediately preceding, and 150 the mean proportion for the ten years —1895-1904. The proportion in 1905 is the lowest hitherto recorded. That urban life is not *per se* incompatible with a low rate of infantile mortality would appear from the fact that of the 217 chief towns of England and Wales, with populations exceeding 20,000 each, at the last census, thirty-two

were credited during 1905 with proportions of infantile mortality below 100 per thousand births. The towns in which low rates of infantile mortality were recorded may, generally speaking, be described as residential towns or suburbs, while those in which high rates prevailed are largely industrial in character. In no fewer than five of these towns, one out of every five children born did not survive the first year of life, whilst in Farnworth the average mortality reached the terrible rate of 228 per 1,000 births, which exceeds the total mortality in the first five years of life in England and Wales as a whole.

COMPULSORY EDUCATION ON THE CONTINENT.

In Italy and France the application of the law with regard to compulsory education is so disregarded that Rome, with a population of 507,000 inhabitants, has only 30,000 pupils in her primary schools, whereas she should send 70,000. About 20,000 of the pupils attend the public schools. In Paris, out of 225,000 children to whom the law should be applicable, 20,000 receive no instruction. This state of affairs led to the recent introduction of a motion in the French Chamber to fine parents who evade the law. It appears to be the practice in many French communities to "inscribe" children who are withdrawn from their classes to work in factory or field. Prussia is cited as enforcing the law for compulsory instruction. In Norway, Sweden, Denmark, and Switzerland all soldiers are said to know how to read and write. The law in Holland has been in force only since 1901, and Amsterdam shows the following increase in the percentage of children attending school:—In 1898, 36 per cent. of the population; in 1900, 44 per cent.; in 1901, 70 per cent. The compulsory law brought about a quick increase of 24 per cent. In a discussion in the Chamber for the adoption of a law for compulsory construction in Belgium, the statistics of 1904 bearing on the instruction of military recruits, were quoted as follows:—17·6 per cent. of almost absolutely ignorant recruits; 11·4 per cent. only had good primary instruction, while 71 per cent. had only the most elementary schooling. The following figures were also quoted concerning the proportion of illiteracy in two groups examined in 1906, of 100 men each. The first group had 30 completely illiterate, 24 able to write their names, and 46 able to read and write. The second group had 19 completely illiterate, 21 able to write their names, and 60 able to read and write. The school reports, between the years 1899 and 1902 were quoted to prove that only 14·6 per cent. of Belgian children received complete primary instruction, a large percentage leaving school with only rudimentary knowledge. The conclusion reached was that the number of children figuring in the scholar lists was no proof of the education of the masses, but rather of the sterility of a non-compulsory school system.

THE PANAMA HAT INDUSTRY.

One of the most important industries of the Republic of Colombia, is that of making palm hats, known as Panama hats, of which a quantity valued at £80,000 is exported annually. This industry follows in importance, those of coffee, gold, hides, tobacco, and rubber in the order named, and is carried on in the department of Cundinamarca, Tolima, Antioquia, and Santander, but mostly in the latter, where it is the breadwinner to more than one half its population. There are no regular factories, but the hats are hand-made by thousands of peasant women in almost as many households, and sold, or exchanged in the local stores for provisions or articles of clothing, the hat being in these regions a convenient medium of exchange; the housewife exchanging the product of her labour for so many pounds of flour, sugar, &c. According to the American Consul at Barranquilla, Panama hats are made with the fibres of a palm leaf, the tissues of which are scraped off, or combed in much the same way as hemp. The palm (*Carludovica palmata*) called locally "Jipijapa," is very small in appearance and grows in great quantities on the low and swampy lands of the Upper Magdalena. It grows wild, but is also cultivated, although to a limited extent, in the largest hat districts, the palm producing in a little over a year. The preparation of the fibre after the tissues have been combed off, consists of boiling the same in water containing salts and lemon juice for the effect of whitening and rounding its surface; this operation takes a few hours. The straw is then exposed to the night air for three consecutive nights, after which it is ready for use. The material employed in the making of a hat is marketed at the equivalent of from sevenpence halfpenny to one shilling and eight pence per hat according to the fineness and whiteness of the straw, the youngest leaves generally giving the best quality. It takes a woman four days to make an ordinary hat, eight days for a good one, and as much as fifteen days for the finest hat made in Colombia. The wages of a peasant woman employed in the making of a "jipijapa" hat are reckoned at fivepence a day, including her food which can be calculated at fivepence additional. The best hats exported from Colombia are those called "Suaza" made in the city of that name in the department of Cundinamarca. The next in order are "Antioqueños," made in the department of Antioquia. Then follow the ones made in the department of Santander, called respectively, "Zapatoca," "Barichara," "Bucaramanga," and "Giron," from the various cities in which they are made, and varying in quality and price in the order named. The "Zapatoca," although the most expensive, are supposed to be less durable than the other varieties. The best Suaza hat exported, costs, on the spot, about twenty shillings. and the cheapest, about four shillings; the Antioqueños are one degree cheaper, while the cheapest of all are those from the department of Santander, which range from two shillings to eight shillings according to quality. Indeed some Panama hats, made at the

rate of one a day, sell for less than two shillings, but these are made exclusively for home consumption and in no way exported. Hats are generally exported by the local merchants, mostly through the agency of a commission house at the port of shipment. In some cases foreign houses buy direct, whereas a few individuals take their own merchandise to the foreign country where it is marketed by them personally. The hats are packed in boxes weighing 132 pounds and containing from 40 to 50 dozens each. As above explained, Panama hats are made in a most primitive way. Accordingly, any machinery which could increase the output materially and reduce at the same time the number of workpeople would be a great benefit to the industry, which is very attractive since it needs but a small capital, and promises good returns to any one engaging in it systematically.

THE UNITED STATES LEATHER TRADE.

There has been a very rapid growth in the American leather trade during the last ten years, according to the United States Bureau of Statistics. The leather industry in that country contributed £30,000,000 to the foreign commerce in 1906, against £11,000,000 in 1896. These figures include the imports and exports of leather and its manufactures, and imports and exports of hides and skins. The value of hides and skins imported in 1906 was about £17,000,000, while in 1896 the value was £4,000,000. Over £9,000,000 worth of leather and its manufactures were exported in 1906, against £3,800,000 in 1896, while the value of these articles imported in 1906 amounted to £3,600,000. The value of hides and skins exported in 1906 was nearly £400,000. Of the £9,000,000 worth of leather and its manufactures exported, £1,900,000 represented boots and shoes, £5,000,000 upper leather, £1,600,000 sole leather, and the remainder, £400,000, harness and saddlery. The United Kingdom took nearly £400,000 worth of boots and shoes, £2,700,000 worth of upper leather, and £1,300,000 worth of sole leather in 1906, against £50,000, £1,500,000, and £1,070,000 respectively, in 1896. The other countries which took large quantities of American boots and shoes were Canada, West Indies (exclusive of Porto Rico), and Mexico, while Belgium, France, Germany, the Netherlands, South America, Australia, and various parts of Asia and Oceana, all took greater or less quantities of boots and shoes, and moreover, many of these countries are good customers for other classes of leather. Of hides, Argentina sent to the United States in 1906, £1,000 worth, India over £400,000, Canada £475,000, France £400,000, and Mexico more than £200,000. The imports of goat skins amounted to £6,500,000, of which India contributed nearly £2,200,000 worth, Mexico £500,000, France £400,000, China £625,000, and, in addition, the United Kingdom, Brazil, Argentine, Arabia and Russia each sent more than £200,000 worth.

ARTS AND CRAFTS.

Apprenticeship and the Artistic Crafts.—There has been a good deal of talk of late about the decay of apprenticeship. Until recently the subject was more often approached from the purely economic standpoint, but we are hearing a considerable amount about it now from the point of view of its effect on the artistic crafts. Some time back it was taken more or less for granted in some quarters that the apprenticeship system was rather in the nature of a survival, that sub-division of labour was bound to bring in its train the abolition of the old method of training, and that, after all, it probably did not much matter. The fallacy of this attitude from an economic point of view has been abundantly proved, and the breakdown of the apprenticeship system is now looked upon as a very serious difficulty, largely responsible for a heavy proportion of unemployment and unemployableness in later life. From the side of art and craftsmanship the matter stands, of course, in a slightly different light. The question is not so much how a man can best fit himself to earn his living, as how he can best learn to be a master of his trade. Some time back it would have been said that all that was required was technical education, that a lad could and would learn at the art school or the technical institute (which, by the way, he very often attended only two or three evenings a week) far more and far better than in the workshop, where his teaching was most likely unsystematic and had to be picked up rather casually in the course of the day's work from fellow workmen, probably uneducated and possibly unintelligent. Few went to the length of wishing apprenticeship to die out, or to see workshop training supplanted by school teaching, but there seemed to be a rather easy kind of optimism afloat which assumed that it did not much matter anyway, and that somehow things would come all right. Of course, the apprenticeship system is not dead. It still goes on in various highly skilled trades, and in others, where it is not the custom for the boys to be indentured, they go first as learners, with a sort of general understanding that they will learn their trade in so many years and at the end of that time will be paid as skilled workmen. This is a custom which may work out at much the same thing as apprenticeship, but at times it certainly does not. Miss King, in her interesting report on the silver and jewellery trades in London, tells us that "a silversmith's term of apprenticeship is usually for seven years," though some of the subsidiary processses seem to be carried on by people who are not formally apprenticed. Still, it is not nowadays by any means the rule for all boys who go into skilled trades to be indentured.

By this time the general faith in technical schools as places where students would, better than in the workshop, learn their trade, has broken down. Many of the schools are doing excellent work in the way of supplementing the training which the lads get in the

shop during the day, and of giving them an outlook which is not merely that of "the trade;" but the schools, as a whole, do not and cannot supply the place of workshop training, and in some of them the standard of technique is deplorably low.

The School of Art Wood-carving.—It is, therefore, all the more refreshing to read the Report of the School of Art Wood-carving for the past year. Wood-carving is a craft which lends itself better than many others to school instruction. In teaching it, it is far more possible to reproduce the conditions of actual trade work than in many crafts which require more elaborate plant and a greater range of methods. What is wanted is competent instructors and a system of management which aims at turning out capable carvers rather than artists with a taste for carving. This appears to be the object which the school keeps in view—and the results are decidedly satisfactory. Not only is there a good attendance of teachers and trade carvers at the evening classes, but the male students who take the full course are turned out as fully equipped and practical workmen, and some of them, at any rate, go straight from the school into trade workshops where they "have received from the start the wages of trained carvers, the school thus taking the place of apprenticeship." The West Ham Borough Council and the Kent Education Committee have taken advantage of the training afforded by the school and send some of their most promising students to profit by the teaching and to be fitted to start in life as competent workmen.

Even allowing for the comparative suitability of wood-carving to school instruction, such a report as that issued by the School of Art Wood-carving is encouraging. We hear on all sides of promising students who can get no work to do, and of manufacturers and others who will have nothing to do with students who have been trained in art schools. A report like this raises the question whether the difficulty has not largely arisen from a mistake in the aim of the teaching. Had the powers that be set themselves to training workmen who should add to a thorough knowledge of technique a certain amount of appreciation of what is best in workmanship and design, they might perhaps have done really more for the encouragement of art than by turning out art students who have an acquaintance by no means thorough with one or two artistic crafts.

Arts and Crafts and Costume.—Not so very long ago the bare suggestion of an exhibition of Arts and Crafts applied to costume would have been scouted as ridiculous. Now the Lyceum Club is opening its doors to a show of such work executed by its members. It is perhaps fitting that such an innovation should be introduced at an energetic ladies' club, and, though the collection of objects is not very large, it is enough to show the kind of way in which women working in the artistic crafts cater for the wants of their sisters. As might have been expected, it is the work of the jewellers which predominates, and though one could wish for a little more control over the material in some of the enamel, the work as a whole is characterised by the judicious introduction of transparent colour, both in the form of enamel and of jewels cut *en cabochon*. The workmanship of the different exhibitors naturally varies, and there is good, bad, and indifferent, but the level on the whole is fairly high, and the work of several contributors, notably of Mrs. Hadaway and Miss Woodward, is thorough, tasteful, and quite sufficiently original.

Passing over such items as fans, bags, purses, and the like, which are, perhaps, hardly to be classed altogether as "costume," we come to the arts more intimately connected with dress. Leather work has been pressed into service, not in the form of artistic boots and shoes, but as supplying some characteristically simple plaited leather belts. There is rather less embroidery than one would naturally have expected to find, perhaps because embroidery as a trade is as a rule so badly paid; but the front and sleeves shown by Mrs. Reynolds-Stephens are very satisfactory. They are not, however, the kind of work which could ever be very much done in a commercial kind of way, as the labour involved in their execution would be greater than the ordinary buyer, ignorant of embroidery methods, would probably be willing to pay for. Another less interesting and far less finely executed piece of trimming contributed to the exhibition, though it is in no way remarkable, is on lines which are nearer to the kind of work for which there should be a market. After all, coarse work has its uses, especially when designed for clothes which will presumably soon be out of fashion.

The dress designed by Mrs. George Turnbull gives food for reflection. As a dress, perhaps, it hardly comes within the scope of these notes, though he would a bold man who suggested that dressmaking was not an art, and in one sense at least it is certainly a craft. Any way, as embroidery, it is well within our province. The garment is made of some thin grey material, and is decorated with padded tulips, of a yellowish pink with green leaves cut out of velvet (painted, stencilled, or printed, it is difficult to say which) and applied with a thick gold or silver cord at the edge. The result if not altogether happy, it is at least suggestive. It is not difficult to imagine a dress in some fairly neutral tint, which would make a good background, ornamented with *appliqué* embroidery in some material not too unlike the ground stuff in weight, though differing from it in texture which might be not only pleasing in design, but quite beautiful in colour. By the way, padded *appliqué* hardly seems suitable for a dress whether from the point of view of elegance or of comfort. The level of work shown at the Lyceum Club is quite good, and there are among the exhibits things which are both fresh and worthy of notice, but the main interest of the show lies perhaps in the connecting thread of purpose which draws the objects together.

GENERAL NOTES.

TURIN PHOTOGRAPHIC EXHIBITION.—An International Exhibition of Artistic and Scientific Photography will be held at Turin, in May, 1907. There will be two divisions, one for amateurs, and the other for professional photographers. Artistic photography will include figure, landscape, marine, flower and animal pictures. Scientific photography will consist of micro-photography and astronomical photography. Applications for space will be received until April 30th, and the objects themselves until May 15th. Application can be made to the office of "La Fografia Artistica," Rue Accademia Albertina No. 1, Turin.

BLACK CURRANT MITE.—The Board of Agriculture and Fisheries announce that a new edition of their leaflet on the "Black Currant Mite" has been published, in which information on the treatment of this pest with lime and sulphur has been incorporated. Fruit-growers whose bushes have been attacked with the mite are advised to experiment with this process. Copies of the leaflet may be obtained gratis and post free on application to the Secretary of the Board of Agriculture and Fisheries, 4, Whitehall-place, London, S.W. Letters so addressed need not be stamped.

THE GERMAN CEMENT TRADE.—The German cement industry is looking back upon the year 1906 as an extremely favourable one; the business was throughout more profitable in every respect than during a number of previous years. The joint stock capital of thirty of the largest works, representing approximately £4,500,000, yielded from £460,000 to £500,000 interest, or, 10·7 to 11·4 per cent. In the year 1905, the dividend amounted to about 8·5 per cent., calculated on a capital of £4,240,000. Dividends of the companies in question, in the last eight years, 1899-1906, were as follows:—14·3, 11·25, 5·24, 4·41, 5·14, 6·58, 8·5, and 10·7 to 18·4 per cent. respectively. According to the American Consul-General at Hamburg, the reason for this favourable development in the industry was chiefly the building activity throughout the country in 1906. Although during 1904 and 1905, a similar activity prevailed, prices suffered in those years from the consequences of over-production. Notwithstanding the fact that in 1905 such an over-production did not make itself felt so much as in the preceding year, the production during the year 1906, although a number of new works were started, did not in general exceed, in a marked degree, the demand. This supposition is confirmed by the statistics of the import of cement during last year. In 1905 exceptionally large quantities were imported, but in 1906 the imports increased further, as the following statistics prove. During the eleven months from January to November of the last six years, 1901-1906, inclusive, the quantities of Roman and Portland cement and hydraulic lime imported into Germany were as follows:—In 1901, 84,185 tons; in 1902, 51,059; 1903, 48,902; 1904, 57,325; 1905, 140,271; and in 1906, 221,449 tons. By far the largest quantities were imported from Belgium, chiefly into Western Germany. The consequence was that the Rhenish Westphalian Cement Syndicate, although it was itself in full activity throughout the year resorted to energetic measures by opening sale rooms in Cleve and reducing its prices to beat down foreign competition. In other respects, however, prices increased slowly but steadily. This favourable tendency was increased by the fact that the feeling among the various German cement syndicates was a more peaceable one than in the preceding years; furthermore, because enormous quantities of cement were exported, in which movement the San Francisco and Valparaiso earthquakes were important factors.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

APRIL 17.—"Aerial Navigation." By MAJOR B. F. S. BADEN-POWELL. SIR BENJAMIN BAKER, K.C.B., K.C.M.G., F.R.S., will preside.

APRIL 24.—"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon. LIEUT.-COL. DAVID PRAIN, C.I.E., F.R.S., will preside.

MAY 1.—"The Defence of the Sea Coast from Erosion." By ALFRED EDWARD CAREY, M.Inst. C.E.

MAY 8. — "The Production of Coke and its Application in Domestic Fires." By PAUL SCHLICHT. CORBET WOODALL will preside.

MAY 15.—"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

APRIL 23.—"Social and Economic Conditions in Australia." By the HON. JOHN WINTHROP HACKETT, LL.D.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

APRIL 16.—"Joinery and Furniture Making." By A. ROMNEY GREEN. HALSEY RICARDO will preside.

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON. J. C. WEDGWOOD, M.P., will preside.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

PROF. HERBERT JACKSON, F.I.C., F.C.S , "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

LECTURE I.—APRIL 15.—Water in its relation to laundry work—Hardness of water and softening agents—Treatment of boilers showing pitting—Soaps and their composition—Easy methods of examining and valuing soaps—Behaviour of soaps with water—Hydrolysis of soaps.

LECTURE II.—APRIL 22.—The alkalies used in laundry work — Their relative values and useful strengths—Bleaching agents—their composition and properties—Methods of applying bleaching agents—Their comparative value—Dangers in the use of bleaches—Methods of valuing bleaches.

LECTURE III.—APRIL 29.—The problem of washing—Textile fabrics: easy methods of distinguishing between them chemically and by the microscope—Shrinkage of woollen goods—Behaviour of various fabrics with detergents and bleaching agents—Influence of acids, alkalies, &c., on the individual fibres—Precautions to be observed.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 15 SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Prof. Herbert Jackson, "Detergents and Bleaching Agents used in Laundry Work." (Lecture I.)

TUESDAY, APRIL 16. SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr A. Romney Green, "Joinery and Furniture Making."

Asiatic, 22, Albemarle-street, W., 3 p.m.

Royal Institution, Albemarle-street, W, 3 p.m. Professor G. H. Bryan, "Wings and Aeroplanes." (Lecture II.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1 Mr. Percy Allan, "The Pyrmont Bridge" 2. Mr. W. H. B. Saville, "Swing Bridge over the River Avon at Bristol."

Statistical, 9, Adelphi-terrace, W.C., 5 p.m. Mr. Albert E. Lark, "The Herring Fishery of Great Yarmouth."

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. A. Marshall, "Some Dutch Pictures"

Anthropological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W, 3 p.m. Mr. R. H Curtis, "Rainfall in its Relation to Horticulture."

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m.

WEDNESDAY, APRIL 17. SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Major B. F. S. Baden-Powell, "Aerial Navigation."

Meteorological, 25, Great George-street, S.W., 7½ p.m. 1. Mr. R. L. Holmes, "Phenomenal Rainfall in Suva, Fiji, August 8th, 1906." 2. Mr. R. Strachan, "Temperature around the British Islands in relation to the Gulf Stream." 3. Mr. L. C. W. Bonacina, "Weather regarded as a Function of Climate."

Geological, Burlington-house, W., 8 p m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. E. M. Nelson, "The Podura Scale." 2. Exhibition of Slides of Foraminifera, by Mr. A. Earland.

United Service Institution, Whitehall, S.W., 3 p.m. Mr. C. Bright, "Submarine Telegraphy."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, APRIL 18 Royal, Burlington-house, W., 4½ p m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. J. C. Shenstone, "The Œcologic Functions of Stolons and Cleistogamous Flowers." 2. Mr. A. O. Walker, "The Œcologic Aspect of Constitutional Variation in Fruit Culture" 3 Mr. Hugh Scott, "An Aberrant Form of Coccidæ." 4. Professor W. B. Bottomley, "Some Results of Inoculation of Leguminous Plants." Exhibitions:—1. Dr. George Henderson—Nepal Barley and other Cereals cultivated at high latitudes in Tibet. 2. Mr. J. A. Weale — Photographs of Sections of Woods. 3. Mr. J. Saunders—Lantern Slides of "Witches' Brooms."

Chemical, Burlington-house, W., 8½ p m. 1. Sir W. H. Perkin, "The Magnetic Rotation of Hexatriene, CH_2:CH.CH:CH.CH:CH_2, and its Relationship to Benzene and other Aromatic Compounds, also its Refractive Power." 2. Messrs. M. O. Forster and H. E. Fierz, "Aromatic Azoimides. Part I. p-Hydroxyphenylazoimide." 3. Mr. O. Masson, "The Action of Hydrogen Peroxide on Potassium Cyanide." 4. Mr. S. Ruhemann, "The Action of Ethyl Oxalate on Thioacetanilide and its Homologues." 5. Messrs. A. McKenzie and H. B. Thompson, "Measurements of the Velocities of Saponification of the l-Menthyl and l-Bornyl Esters of the Stereoisomeric Mandelic Acids." 6. Messrs. A. G. Perkin and W. P. Bloxam, "Indican." (Preliminary notice.) 7. Mr. P. C. Ray, "Cupric Nitrite." 8. Mr. M. Barrowcliff, "The Constituents of the Essential Oil of American Pennyroyal. Occurrence of a Dextro-Menthone." 9. Messrs. T. E. Gardner and W. H. Perkin, "The Action of Tribromopropane on the Sodium Derivative of Ethyl Acetoacetate."

Royal Institution, Albemarle-street, W., 3 p m. Professor Henry A. Miers, "The Birth and Affinities of Crystals." (Lecture II.)

Optical, 20, Hanover-square, W., 8 p.m. Presidential address by Mr. Walter Rosenhain, "Physical and Engineering Uses of the Microscope."

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p m. Mr. A. Schwartz, "Flexibles: with Notes on the Testing of Rubber."

Historical, Lecture Hall, Field-court, Gray's-inn, W.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, APRIL 19 ..Royal Institution, Albemarle-street, W., 9 p.m. Prof C. F. Sherrington, "Nerve as a Master of Muscle."

North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7½ p.m. Mr. A. E. Long, "Trim Curves."

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

Women Journalists (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8½ p.m. Mr. Alexander Kenealy, "Illustrated Journalism."

SATURDAY, APRIL 20...Royal Institution, Albemarle-street, 3 p.m. Prof. Sylvanus P. Thompson, "Studies in Magnetism." (Lecture II.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 22, 8 p.m. (Cantor Lecture.) PROF. HERBERT JACKSON, "Detergents and Bleaching Agents used in Laundry Work." (Lecture II.)

TUESDAY, APRIL 23, 4.30 p.m. HON. JOHN WINTHROP HACKETT, LL.D., "Social and Economic Conditions in Australia."

WEDNESDAY, APRIL 24, 8 p.m. (Ordinary Meeting.) HERBERT WRIGHT, "The Cultivation of India Rubber."

*** A Collection of Samples of India Rubber, principally Colonial, will be exhibited at the Meeting, and will remain on view for a few subsequent days.

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

On Monday evening, 15th inst., PROF. HERBERT JACKSON, F.I.C., F.C.S., delivered the first lecture of his course, on "Detergents and Bleaching Agents used in Laundry Work."

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

Tuesday evening, April 16th, HALSEY RICARDO in the chair. The paper read was "Joinery and Furniture Making," by A. ROMNEY GREEN.

The paper and report of the discussion will be printed in a future number of the *Journal*.

MULREADY PRIZE.

The Council of the Society of Arts are prepared to offer, under the terms of the Mulready Trust, a Gold Medal, or a prize of £20, for competition amongst students of the Schools of Art of the United Kingdom, at the Annual National Competition to be held in 1908.

The prize is offered to the student who obtains the highest awards in the following subjects:—

(*a*.) A finished drawing of imperial size from the nude living model.

(*b*.) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses (mounted on not more than two imperial size mounts).

(*c*.) A set of studies of hands and feet from the living model (mounted on not more than two imperial size mounts).

(*d*.) Drawing from the life, including memory life drawing done at the Examination in May, 1908.

No student will be eligible for the award who does not pass in the Examination (*d*) in drawing from the life, and who does not obtain an award for (*a*) the finished drawing of imperial size from the nude living model. The other two subjects are optional.

The works must have been executed between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1892, 1893, 1896, or 1903, cannot compete again.

The drawings, &c., are to be submitted, with other school works, in the usual manner to the Board of Education, South Kensington, in April, 1908. Each competing drawing must be marked "In Competition for the Mulready Prize," *in addition* to being labelled according to the Regulations of the Board of Education.

PROCEEDINGS OF THE SOCIETY.

SEVENTEENTH ORDINARY MEETING.

Wednesday, April 17, 1907; SIR BENJAMIN BAKER, K.C.B., K.C.M.G., F.R.S., Vice-President of the Society, in the chair.

The following candidates were proposed for election as members of the Society:—

Felberman, Louis, Bladen-lodge, Bolton-gardens South, S.W.
Foucar, Alexandre Ferdinand Emile, Beaulieu, St. John's-park, Blackheath.
Shaw, Mrs. G. Bernard, 10, Adelphi-terrace, W.C.

The following candidates were balloted for and duly elected members of the Society:—

Aird, Mrs., 22, Eaton-square, S.W.
Charlier, Edgard, 19, Lerchenfeldstrasse, Munich, Bavaria, Germany.
Ghosh, Henry A., 9, Middle-road, Entally, Calcutta, India.
Griffin, John R., Kemble-street, Kingsway, W.C.
Khan, M. Habib ur Rahman, Habibganj, District Aligarh, India.
Mukharji, Sivnarayan, Uttarpara, near Calcutta, India.
Percival, Professor Hugh Melville, M.A., 14, Park-street, Calcutta, India.
Ransome, Ernest L., Westervelt-avenue, Tompkinville, Staten Island, and 11, Broadway, New York City, U.S.A.
Reid, Hugh, D.L., J.P., M.Inst.C.E., Belmont, Springburn, Glasgow.
Reitlinger, Albert, 33, Fitzjohn's-avenue, N.W.
Wood, E. Escott, Hurricane-house, Brymbo, North Wales.
Woolner, A. C., M.A., Punjab University, Lahore, India.

The CHAIRMAN, introducing the reader of the paper, said the members of the Society had, on a former occasion, the advantage of hearing Major Baden-Powell read a paper on the subject of his present paper. Anyone interested in the subject knew that the author was one of the earlier experimenters and authorities on it. The theatre of the Society of Arts was the only one in London, he believed, which welcomed discussion on any subject of national or public interest; and as the subject of the paper was one which was exercising a great deal of public attention at the present time, the Society was indebted to the author for again drawing attention to it. He hoped the discussion would be a good one, but personally he could only contribute to it incidentally, as he was not an expert on the question, his career having been in the opposite direction, of preventing structures designed and constructed by himself, such as bridges and roofs, from becoming flying machines.

The paper read was—

AERIAL NAVIGATION.

BY MAJOR B. F. S. BADEN-POWELL.

INTRODUCTION.

In the following paper I propose to refer briefly to three special points. I say "briefly," because each of them forms a subject on which volumes might be written.

First, I intend to indicate how vastly important the subject of aeronautics may become in the future, and that this future may not be so very distant. Secondly, I would refer to some of the general principles of aerodynamics, and thirdly will relate such facts as I have been able to ascertain as regards aerial machines which have, during the last few months, undergone successful trials.

I am one of those who believe that we are just about to enter an era of great change in human life. Various inventions have been introduced at different periods which have had a great influence on the progress of the civilised world; the steam-engine, the railway, the telegraph, the steamship, and many others. But it would now seem as if all these were to be outdone by an innovation still more affecting our daily life. Progress in invention is nowadays so rapid (as an instance take the introduction of the motor-car) that but a very few years are required to introduce an absolute novelty into everyday use.

Just recently, during the last two or three years, immense progress has been made in steps towards the practical navigation of the air. I will not now refer to balloons, since although propelled, gas-filled airships have lately been so improved as to be adopted as practical vessels of war, yet it looks decidedly as if these must go under and become quite obsolete the moment anything in the way of a gasless machine proves practicable.

It will perhaps hardly be necessary to define what I mean by a gasless flying machine. Everyone nowadays has a general idea of the aeroplane or propelled kite method of transportation through the air.

RECENT PROGRESS.

Ten or fifteen years ago authorities writing on the subject stated that if only it were possible to make engines so light as to weigh but 10 lbs. per horse-power there would be no difficulty in constructing a flying machine. A few years after, petrol engines were made of such a weight. To-day they are made, and on the

market, weighing no more than 2½ lbs. per horse-power!

Sceptics used to say that it would be impossible to raise a large apparatus off the ground by engines and propellers. To-day this has been accomplished, not once but on many different occasions. They also urged that, once in the air, it would be impossible to balance the machine in steady flight. Now, although this has proved somewhat of a stumbling block, we hear of men maintaining themselves for half an hour at a time in mid air while being propelled along at a great speed. Many have declared the landing would be a difficulty, but, even without considering these recent flights, we know that thousands of glides have been made with man-carrying gliding machines that have almost always ended satisfactorily.

So it seems as if all arguments against the attainment of practical flight could be controverted, and as so much experimenting is now going on, there seems a great probability that not many years will elapse before we are able to fly hither and thither where we will.

Characteristics.

Such a machine would probably travel very fast indeed; there are no bumpy roads; no children, dogs, or chickens to get in the way; no abrupt turnings or sudden apparitions of crossing vehicles to be considered; the air is nearly frictionless; the view for several hundred yards is nearly always clear; if one can go up or down as well as to right or left, obstacles and other machines are more easily steered clear of than is the case with wheeled vehicles or marine vessels. Wear and tear of machines skimming through the air is likely to be nothing as compared to means of travel by land or by sea.

It will not be necessary here to speculate at any length as to the uses of such machines. In war they will evidently be of supreme importance. If, as appears probable, they can be constructed at less cost than a motor-car, they should soon come in for everyday travel. Though it may not, at first, be easy to transport heavy goods by this method, yet mails and light articles might be dispatched. Seeing that one can go straight from door to door, independent of roads or bridges, the rate of travel is again increased. But perhaps the most remarkable innovation—one which will call for the serious consideration of our legislators, is the ability to pass all barriers, crossing not only walls and fences into private property, but also international frontiers.

But now let us get to some more practical aspects of the question. We want to know more about what the airship of the future is to be like. Only a few years ago, with no experience to go upon, no one could say much authoritatively. But now, although there is still very much to learn, and we are but scratching the surface of the subject, many facts have been ascertained which throw considerable light on the question.

Aerodynamics.

It is necessary for those who would design an airship, and many minds are now being concentrated on that objective, to make some study of the principles of aerodynamics, and though it would be quite impossible to go at all thoroughly into the subject in a paper such as this, my object is to touch upon a few main points, and I hope to elicit the opinions of those who have made study in these lines, or who can suggest a scientific explanation of some of those points which seem at present rather obscure.

The science of aerodynamics, that is to say the study of the reaction of the air on bodies moving through it, has only recently been seriously taken up. As I have pointed out elsewhere, many text-books of to-day in referring to wind pressures, quote, word for word, a table concocted by a practically unknown authority no less than 150 years ago! Yet recent careful observations tend to show that this table is quite misleading. I need not here relate the various experiments which have been made to determine the pressure of the wind at a given velocity, as I have summarised them in a recent article in "Knowledge," but I will merely state that it is now pretty well decided that the pressure (in lbs. per square foot) exerted on a surface moving against the air is somewhere about ·003 times the square of the velocity in miles per hour. In the table referred to, Rouse made the figure ·005. This subject, as applied to wind pressures, is one on which there are few better authorities than our worthy chairman of to-night.

It has been proved that the size and shape of the body may make some difference in the relative pressure per square foot, as may the velocity when considering very high speeds. What we are now considering is the pressure developed on a plane surface moving at right angles. But when this surface is inclined, other complicated calculations come in.

In considering the action of the air on

plane surfaces at an inclination, the student of aeronautics must again be warned not to trust what he may see in older books treating of the matter. Newton contended that the pressure on such a plane varies as the square of the sine of its inclination, or to put it in less mathematical language, as the plane becomes more upright the pressure increases as the square of the angle. Langley, in his elaborate experiments, as well as others, have proved this to be quite erroneous, so that when a plane is inclined at a very small angle, instead of the pressure rapidly becoming almost nil, it remains very considerable. Thus, at an inclination of 5°, according to Newton's theory, the vertical upward pressure would be but ·0076 of that on the plane placed normally, while Langley found it to be ·15, or no less than twenty times as great.

Chanute, summarising the conclusions of many experimenters, has shown that the formula of Duchemin

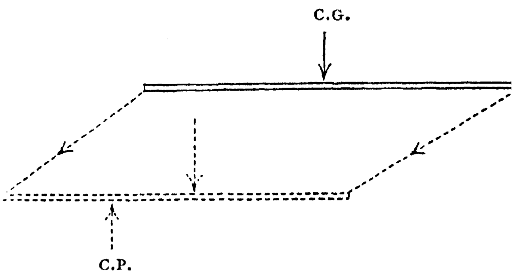
$$P = P^1 \frac{2 \sin \alpha}{1 + \sin^2 \alpha}$$

is probably about correct, as the proportion between P, the pressure on an inclined surface, and P^1, that on the surface if placed perpendicular, α being the angle of inclination of the surface.

But, even with such formulæ before us, it is by no means easy to calculate what speed must be given to an aeroplane in order to support a given weight. Theoretically this can be done straight off but in practice it is different.

Let us start by taking a flat piece of paper. If this be held horizontally and dropped, it ought according to theory to fall directly downwards at a given rate. Now see what happens. It is evident that, drop it as carefully as we like, it will always start swaying about and moving from side to side till it falls over. In looking for a cause for this, we find a fact, which has been investigated by Langley and others, that with an inclined surface the centre of pressure is not in the centre of the surface, but towards its front edge, and that the more the surface is inclined, the further, up to a certain point, does this centre advance. This is known as Joëssel's law, his formula being $C = (0{\cdot}2 + 0{\cdot}3 \sin \alpha)\,L$, when $C =$ centre of pressure, L the length from front to rear, and α the angle of inclination.

This being the case, it is easy to see that directly our sheet of paper while falling moves towards one side or other (and as its edge offers so little resistance it is very liable to do so), then instead of meeting the air at right angles, as in falling perpendicularly, it meets it at an angle, thus :—



But by Joëssel's law the pressure will then advance towards the front, instead of being in the centre of the surface, and this must cause the advancing edge of the paper to turn upwards. When the paper is thus tilted the centre of pressure moves back, and the paper will tend to resume its former position. So we obtain a swinging pendulum action which increases more and more.

SPINNERS.

This brings us to an interesting little experiment which might possibly be taken advantage of in aerial apparatus.

If we take an oblong piece of paper, narrow in proportion to its length, this action becomes so intense that the paper when dropped will spin rapidly about its longer axis. On trying different shaped pieces of paper, we soon find several facts. The narrower the paper in proportion to its length, the faster it spins. We also notice that such an arrangement falls comparatively slowly to the ground. But we also may note that it always falls at a fixed angle. The narrower the paper the steeper the angle of fall—about 45° An arrangement such as this has been suggested as a parachute or safety appliance in a flying machine, both by Mr. Dunne in this country and by Herr Kœppen in Germany. This, though an interesting subject on which much might be said, is but a digression.

BALANCE.

Now if we want the paper to fall steadily it will be found that, unless we suspend a heavy weight below it, it is necessary to let it fall sideways—by arranging the centre of gravity towards the leading edge. Then the paper will fall in an inclined direction as before, but if the weight be on the centre of pressure as shifted it will fall steadily at the given inclination. However, this shifting of the centre of pressure is, as we have seen

dependent on the angle of inclination. Taken as a general rule, we find experimentally that if the centre of gravity be at a point just about one-third (but more correctly ·3) of the width of the paper the latter will glide down fairly stably. Working this out by Joëssel's law α should equal nearly 30°. Here is a piece of paper to which a string is attached exactly one-third across from the edge. It is so weighted that when suspended by this string it hangs just horizontally; on starting this with a slight push forward it will glide nicely through the air.

But this gliding is not well explained. One might have expected this paper to fall down at an angle of 30°, whereas what it does is, after falling a certain distance and getting up a certain speed, it goes horizontally and even rises in the air. This, again, is due to the pressure coming gradually more to the front as the speed increases. And I have here another model which may seem at first to show some inexplicable effects. It is usual to consider an aeroplane as a plane surface driven against the air at a certain definite inclination, which results in a certain pressure on the under surface. In fact, it is considered to be precisely the same action as that of the wind on a kite. But now in this case you may observe that there are three planes one behind others, each of which is set at a small *negative* angle —that is to say each plane points slightly downwards. Yet, on pushing this forward, it will be seen to travel horizontally and even to rise. This would seem to imply that it is not necessary for the air to impinge upon the under surface, but that some action is caused on the top of the plane.

Another point, which we find by experiment, is that narrow planes are more efficient than wide ones.

Here I have a paper plane, with centre keel to keep it straight, and suitably ballasted in front. You will observe that, when this is projected forward, it will first rise, owing to the shifting forward of the centre of effort. Then it will fall back again, and turn again, till it falls headlong to the ground. Now take an exactly similar paper, similarly weighted, and cut it into a number of transverse slips—so as to present a series of narrow planes—and you see it glides fairly steadily.

Back Suction.

In considering the pressure on a thin plane surface one is apt to ignore what goes on behind it. In addition to the actual pressure on the front side there must be a negative or suction action on the back. Here is an experiment which is often considered somewhat mysterious. A rigid plane surface has a light movable surface hinged to the front edge of its back or upper side. When a current of air is directed on to the face of this it will be seen that the thin piece of paper, which should be screened under the lee of the rigid piece, rises up. This action, it seems to me, may be explained as follows: — Between the two layers of paper exists a film of air at ordinary pressure. When the current of air passes over the front edge, it draws along with it some of the air above the thin paper. This portion being deprived of its full complement of air, a partial vacuum is formed, and the thin paper, with vacuum above and ordinary pressure below, must rise up.

Another important fact in aerodynamics, unknown till Langley demonstrated it some fifteen years ago, is that a plane surface propelled horizontally through the air will fall more slowly than one falling vertically without progressing. This fact may sound peculiar, but it is easily explained. With the falling plane, the air is pressed away from the under surface and has to find its way round to fill the vacuum which would otherwise be formed above. This takes time, but before the requisite time has elapsed, the plane has moved forward and has a fresh lot of air to deal with. Langley only experimented on speeds up to about 45 miles an hour, and it would be very instructive to know what the results would be at higher speeds. This is a very important law as affecting aerial machines—for it implies that by travelling very quickly we can obtain great lifting power. Langley compared the action to that of a skater who proceeds rapidly across thin ice, ordinarily unable to bear his weight, but which has not time to break under him.

Curved Surfaces.

Lilienthal first pointed out, or rather laid stress on the fact, that slightly curved surfaces, concave underneath, were more efficient as sustainers than flat planes. Notwithstanding the theories he advanced, the exact action of the air on these concave surfaces is not well understood. It has also been shown that when the concavity is pronounced near the front edge, that is whilst the section of the surface is thus, a revolving eddy is formed under the front part, which seems to assist the

whole to progress forward. Hargraves stuck small feathers on the under surface of such a body, and these when exposed to a strong current of air, were blown towards the front.

But again we have to look to the upper side as well as the lower, and here we find a very odd effect. The air striking, or struck by, such a curved convex surface is thrown off upwardly, so that a partial vacuum is formed. This is well instanced by a little toy consisting of a light ball, against which a jet of air is blown. The ball remains suspended at a certain distance above the orifice of the jet. But now if the jet is inclined, to say as much as 60° with the horizon, the ball still remains suspended and does not fall to the ground. This is not easy of explanation, but must be due to some such cause as that referred to above.

Combined Effects.

To summarise these facts we find that with a body (say of a bird shape), parts of which are horizontal or inclined at a small inclination, driven rapidly through the air, the faster it travels the slower is its rate of fall. The portions of the body at a small degree of inclination are pressed upward with a considerable force. That the upper curved surfaces tend to cause a partial vacuum above sucking the body upwards, that the concave parts beneath only tend to lessen the forward resistance. All these favour the action of a flying body.

Here I have a little model of the general shape of a bird with wings half closed. It is propelled by two little screws rotated by twisted rubber, and you will see that it flies along rapidly in a horizontal course. But like all aeroplanes it requires careful balancing, not, as may often be thought, transversely (for a weight towards one side makes but little difference), but in a longitudinal sense. If dropped from a state of rest it at once falls on its head. Yet, if weighted so that the centre of gravity is near the centre of the figure, it will not fly at all, but at once points its nose straight upwards and turns a somersault backwards.

Actual Machines.

There are many other inexplicable problems not yet worked out, and is it to be wondered at if, under these circumstances, some of the larger models and man-carrying machines have been found to behave erratically, and not progress along on an even keel? During the last year quite a number of machines have been built in France, comprising large aeroplane surfaces propelled by screws. But one and all of them, after getting up a good speed on the ground, and then rising into the air—and this alone is a great triumph—have very shortly after toppled over and have fallen heavily to the ground. The two machines of Santos Dumont, those of Vuia, of Bleriot, and Delagrange, have all followed the same course. That of Elletrahmur, a Dane, is also said to have risen a few feet off the ground. The Wright Brothers have managed to stay up for long periods, but as far as one can gather facts it seems that this feat is only to be accomplished by the expert steering and balancing by these experienced aeronants, who have for several years been practising and making thousands of glides through the air in their motorless aeroplanes. These machines have been fully described and illustrated in the papers during the last month or two so that a detailed account of them is hardly necessary, but here is a Table summarising recent trials, from which important facts may be gathered as to the power, speed, and surface necessary to raise a given weight off the ground.

Aeroplane Machines.

	Span.	Area.	Total weight with operator.	Engine.	Propeller.		Speed attained	
					Diam.	Revs. per min.	On ground	In air.
	ft.	sq. ft.	lbs	h.p.	ft.		Miles per hour.	
Wright	40	480	925	24	2	—	—	38-40
S. Dumont (1)	39	560	550	50	6	1,000	24½	22-26
,, (2)	36½	146	500	50	6½	—	25	—
Bleriot ...	25½	140	600(?)	24	5¼	—	—	—
Delagrange	32·0	645	638	50	6·9	1,500	—	15
Vuia	—	215	605	—	7¼	—	—	—

All the machines are of much the same general type. All consist of one or more aeroplane surfaces, driven by a single screw propeller, about 6 feet diameter, mounted on wheels to run along the ground. The area varies from 1 to 3 lbs. per square foot of sustaining surface. The speed is from twenty to thirty miles an hour. This speed is very low compared to what one would expect an efficient machine to have. At such a speed, the pressure on a vertical surface would be from 1 to 2 lbs. per square foot, whereas if the speed were increased to 60 miles an hour the pressure would be 10 lbs.

per square foot. Of course it is really remarkable, or would have been considered so a few years ago, to get a speed of even 20 miles an hour over a grass field. But it is palpable that if by any means we can get up such a speed as 60 miles, in which there ought to be no difficulty, the lift should be merely 10 times as great.

But these trials teach us but little of the stability of the apparatus when in mid-air. I do not myself believe that this problem offers any insurmountable obstacle. I am inclined to believe, as the result of observing the behaviour of perhaps hundreds of small models, that an apparatus can be contrived which will automatically balance itself in the air, and even in a puffy wind, and if we can only arrive at the exact shape required (and there are doubtless many different shapes equally efficient) then it seems as if there was little else required before we can practically navigate the air. An old song said "We've got the ships, we've got the men," and we might add "we've got the engines too," but we must make sure, that these ships are stable and capable of pursuing their course, else we shall find that we have a deficiency of men !

DISCUSSION.

Mr. E. F. T. BENNETT asked the author if he would further explain the action of the flight of a dart.

Mr. W. H. MASSEY said he would like to call attention to a point which, in these days of sensational journalism, had been often concealed by design, namely, the danger of coming down. He hoped the Society would do something towards calling the attention of the British public, and especially of inventors, who were sure to break their necks unless they were very cautious, to that very grave danger. Major Baden-Powell had alluded to the fact that there was some difficulty, but he thought he had treated the matter too lightly. There was no difficulty whatever in making a machine which would run along the ground and raise itself and fly—supposing the atmospheric conditions to be favourable—any distance. He did not think with petrol there ought to be any difficulty in making a machine which would carry a ton of dynamite at nearly one hundred miles an hour for perhaps thirty hours, which would take one to America. Therefore, as far as the lifting and flying of the machine went there was no difficulty; but he did want people to realise how extremely difficult it was to come down safely. He supposed an economical speed for an aeroplane would be about 80 or 90 miles an hour. When one suggested to an inventor of a flying machine that there was a difficulty in stopping or unloading passengers or coming down, the inventor replied "Oh, there is no difficulty; use a parachute." If, however, when travelling in a train going at 50 or 60 miles an hour, you put a toy parachute out of the window, it would be realised how exceedingly difficult the thing was; in fact, it was impracticable. He had been thinking over the matter long before Maxim had carried out his experiments, and he had looked through scores of proposals for flying machines, but as far as he could see it was absolutely impossible to come down safely. People did not want to be encouraged to break their necks, and he hoped the Society would assist in making it plain to the world at large that until something was devised to make it possible to come down safely, it was worse than madness to continue reckless experiments in flying.

Mr. REGINALD MYER thoroughly agreed with the last speaker that, as things were at present, flying machines were impossible. He thought the engines which were necessary for flying machines were not, under existing circumstances, sufficiently powerful for their bulk. In some experiments carried out quite recently, it was found that not a single machine was capable of lifting its own weight. When the last speaker mentioned dynamite, he thought he was touching upon an idea which would eventually solve the problem of flying machines, namely, the use of high explosives for propelling engines. If the force of the explosion of dynamite or nitro-glycerine could be bottled up so as to be a little more gradual in its effects, a cwt. or so being capable of being exploded in small quantities, he felt sure it would lighten the engines of a flying machine so considerably that the possibilities of working them successfully would be very much increased; and if it was possible to work engines with a high explosive, the future of the flying machine would be very much more satisfactory than it was under the existing conditions.

Mr. MASSEY explained that he mentioned dynamite because Maxim's experiments were directed entirely towards aeroplanes for military purposes as a means of carrying explosives a greater distance than a gun.

The CHAIRMAN said that it was a fallacy to suppose that dynamite could be used as an agency for motor power, and the fact was quite recognsied.

Mr. C. R. MARTIN asked the author to give further information with regard to the action of two superimposed planes, and the utility of an upper plane.

Mr. T. W. R. CLARKE thought previous speakers had exaggerated the dangers of flying machines,

because if the records were referred to, it would be found there had been only one fatal accident of late in landing from the machines. The lamented deaths of Lilienthal and Pilcher were caused not so much from the difficulty in making the landing, but owing to the machines being too weak. The machines were of the single plane type, which possessed the disadvantage that it is very hard to stiffen them, and it was owing to the collapse of the machines in the air that the deaths occurred.

Mr. WALTER REID, after expressing regret that the author had not shown the very interesting models which he possessed, in referring to the question of high explosives, said he thought it would be the utmost folly to attempt to use nitro-glycerine. A cheap safe explosive could be obtained of petrol, mixed with air, and it was not necessary to get a greater power than the author had shown aeronauts already possessed, motors having been constructed weighing less than 2 lbs. per horse-power. That was very far in advance of any power that the flying organisms in Nature possessed. If one imagined that a bird weighing 2½ lbs. had the power of a horse, they would come to the conclusion it had as much power as was required. The important point was to apply that power, and that was the difficulty to be solved. The question of wind pressure was the first subject to be considered, and in that connection Professor Nipher of Washington University had made experimental demonstrations. By means of an anemometer he proved that the wind pressure recorded on the wall of a building against which the wind blew directly was not the true wind pressure. It was also important to remember that the same result was not obtained if the wind pressure was taken by an apparatus which was standing still, and if it was passed through the air. The only true way in which to test wind pressure for aeronautical purposes was to have the object with which the wind pressure was being tested in motion, because it created currents of air as it passed through the air quite different from what were created if the wind was simply blowing against it. Professor Langley had what he called a whirling table, an instrument with a very long rotating arm, at the end of which he put his apparatus. He did not think experimenters ought to go into mathematical formulæ until they had worked the subject out further experimentally, because they were dangerous unless the data were correct to begin with, and they were not quite certain that at present the data were right. He would therefore rather see an inventor, even if he was insufficiently informed as to what others had done before him, work with his hands and make a thing that would not fly, rather than he would see a perfect formula put down on paper to deter those who wished to make machines. One point with regard to the width of planes which perhaps required working out more than any other was that narrow planes were very much more efficient than wide ones. Nearly the whole of the apparatus that had been constructed hitherto had rather wide planes; and if there was one thing more certain than another it was that the same bearing surface could not be obtained by putting one plane close to the other and piling them up in that way, the dead air from the one detracting from the buoyant action of the others. It was necessary to be very careful indeed, with a fluid like air, to have the planes at considerable distances from each other, whether before and behind, or below and above. As honorary expert to the Aero Club, he had lately had a good deal to do with aeroplanes, and he had found that was one fault which nearly all inventors made. They thought that a wide area had a very large sustaining power when it was going through the air rapidly, but that was not so. There was a very great loss in friction to begin with, and if the sustaining membrane were impervious it was worse still, because a membrane that allowed air to pass through it got rid of some of the dead air, exactly in the same way as a bird's wing did. He had also noticed that nearly every inventor used a fan of some kind, or helix. So far as his own experiments went and those of others, he thought a wing was far more efficient than a fan, the difficulty being the mechanical moving of the wing. The problem was a totally different one from the movement of ships in water, because water was a dense fluid, and the bulk of the vessel was propelled through the air by means of action on the water. In the air, however, the problem was totally different, and his experience went to show that the wing form was more efficient than the fan, though he would not say that a fan could not be used. If a fan was used, however, it should be remembered that the central part was useless. It was of very little use in water, a boss having to be put on to guide the currents away from it, and in the air it was worse than useless. The most efficient propellers were those which had a plate at the end of an arm, which allowed the air to circulate freely round the shaft. In moving through the air, suction was created, as was demonstrated by the author's experiment, but with a certain breadth of the plane moving through the air a suction in front was also obtained. It was a very well known fact that certain forms of valves were in existence in which if a stream were blown against them they went against the current going towards it, and that fact was of the very greatest importance in dealing with aeroplanes. The question of coming down was an extremely difficult subject, but it had been very efficiently solved with balloons. Earlier aeronauts were dragged over the ground, their limbs were injured, and great damage was done; but now by means of the rip valve they were able to come down pleasantly and easily. He thought in the same way, human ingenuity, once they were able to get up and go along safely, would devise a safe means of coming down; but in the meantime he advised

anyone who wished to try the experiment to do so over water, and to learn how to swim first.

Mr. James Roberts enquired whether any observations had been made with regard to the fact that birds, apparently without any exertion on their part, could keep up so well with the wind, and whether any discoveries had been made which would facilitate the construction of flying machines, because he thought the principle which underlay the question of the flight of birds would give the key to many of the problems under discussion, which were often undiscovered for want of the necessary facilities for observation.

Lieut.-Colonel Allan Cunningham stated that, having seen the machines exhibited at the Agricultural-hall, he noticed that the majority of them were woefully deficient in balance, some in lateral balance and others in longitudinal balance, but they were not deficient in power for the size of the machines and the distance they were intended to fly. A great number of the machines came to grief very soon after leaving the exhibitors' hands from that cause. One of the most successfully balanced machines had a string fastened to its tail, and the exhibitor by pulling the tail was able to guide the machine, which did not plunge forward as many of the others did. By that means the exhibitor was able to keep the nose of the machine up, and in that way it flew in quite a respectable manner. In another machine the power was applied to the wrong place. The source of power was derived entirely from a sort of rocket applied to the tail, which caused the nose to plunge down almost immediately. The power required to be applied in some way to be determined upon by experiment, and partly depended on the centre pressure when the machine was in motion and partly on the centre of gravity. As a flying machine was wholly immersed in the fluid in which it was moving, it was natural to suppose that the problem to be worked out was similar to that of the submarine boat, which was wholly immersed in the fluid in which it moved. Those two kinds of motion were quite different from that of a ship, which was floating in the water with the heavy part immersed, and a great deal of the hull above the water. The problem of balance had been solved with considerable success in submarine boats, and he thought that by studying the problem of the balance of aerial machines great progress ought to be made; but until that was done much success could not be expected.

Mr. C. R. Martin stated that if anyone desired to watch birds they could so so on the cliffs between Folkestone and Dover. If they hid themselves behind the bushes on the cliff side they would see many hawks and other birds at close quarters. As far as he had been able to see, a hawk never aeroplaned; he always balanced himself on his wings when he was moving along, and he therefore thought that a hawk as a sample to copy was a mistake. It appeared to him that most inventors of aeroplanes had taken the hawk as their example.

Mr. E. F. T. Bennett remarked that birds in a wind could remain quietly without moving at all, which carried out the author's arguments.

Mr. Walter Reid, in reply to Col. Cunningham's remark with regard to the Howard machine, which obtained the second prize at the Exhibition, stated that a piece of tape was tied to the rear of the machine, but it was slack all the time. Trials were without the tape, and the machine then went better even than with the tape, because it went for a distance of 108 ft. 6 in. as against 71 ft. 4 in. with the tape.

Mr. Percival Spencer remarked that, being an aeronaut, he naturally took an interest in anything connected with the mastery of the air, but the lines of progress which he had thought the best to go along were by means of propelled balloons. He thought in the present state of knowledge a propelled balloon was the most satisfactory means of aerial navigation, because with an elongated balloon, with the power underneath, it was possible to go in any direction. That had been demonstrated to be a practical success. The French Government seemed to be of that opinion, inasmuch as they had taken up the Lebaudy airship, "La Patrie," and were using it for military purposes with entire success, it being capable of going a journey of many miles and coming back again. The fact that the navigable balloon was, for all practical purposes, a success, pointed to the necessity of it being taken into consideration in connection with the subject under discussion. There was no doubt, however, that the development of a machine heavier than air in the form of the aeroplane required careful study, and that the theory had been largely advanced by the experiments the author had conducted. He could not help thinking nevertheless that practical results and tests were more to be relied upon than theories, which were so often based on wrong foundations. In the recent practical tests that had been made, the Howard machine seemed far and away better than any other, it actually flying, and being of the simplest possible construction; whereas the machines of the box-kite type seemed to owe what amount of progress they made not to the flight but to the amount of push the inventor gave them. He remained in hopeful expectation that the development of flying machines would progress on satisfactory lines, and that he might shortly be in a position of leaving his trusty balloon, and taking to a flying machine which would satisfactorily carry him through the air.

Dr. Scott Tebb thought that from a military point of view, the subject was of extreme importance, be-

cause once flying machines were practicable, war ould be altogether stopped. Being a medical man, he was interested in the fact that birds had air sacs in connection with the body, while their bones were quite hollow, so that when they breathed they could practically blow out the body. He desired to ask the author whether that had any effect on their flying capacity.

Mr. J. K. COLLETT expressed the opinion that the problem of aerial transit was capable of solution, and that it was about to be solved.

Major BADEN-POWELL, in reply to the discussion, stated that a paper dart was simply an aeroplane, the pointed front of the folded paper causing the weight to come in the front. If such a dart which went through the air well was tested, he thought it would be found that its centre of gravity was very nearly ·3 of the surface back. He did not agree with Mr. Massey's remarks with regard to the danger of landing. Several inventors had made numerous experiments with gliding machines, jumping off a hill side, or by other means gliding down through the air to practice the balancing of a machine in the air, and no serious accident had ever happened. It was true that both Lilienthal and Pilcher were killed in making experiments of that kind, but in both cases it was not due to the landing; the machines broke in mid-air, or were upset by a gust of wind when at a considerable height. It might be said that was not quite the same thing, because the machine was not heavy and was not travelling at a great speed, but if such machines were able to land in safety, he did not see any argument why a bigger one travelling faster should necessarily be more dangerous. Reference had also been made to a flying machine travelling at the rate of 90 miles an hour, but it did not necessarily mean that the machine would be going at that rate at the moment of landing; it could then be slowed down. There were means of stopping the way of the machine, by tilting up the tail or the bows, and he did not see why there should be any more difficulty in stopping a flying machine than a bird experienced in stopping its flight. Somehow a bird always landed all right on its feet. Another speaker had referred to machines not being able to lift their own weight, but he (the author) had mentioned four machines which, though they had not made very successful flights, had at all events risen off the ground by their own power. With regard to the question of engines worked with high explosives, it seemed to him that the whole object of an explosive was to burn it as rapidly as possible. If it was required to burn slowly, there was an excellent fuel in coal, which he imagined would be much more economical than using dynamite. As Mr. Reid had remarked, he did not think it was necessary to trouble about the question of power at all, because very powerful engines could now be obtained with small weights. A question had been asked with regard to the action of two superimposed planes and the utility of an upper plane. He believed the chief idea of designers who made machines with two planes was that so much more strength was obtained, and that it was structurally convenient to place one plane over another instead of side by side; but he did not know that anybody had proved there was any special object in having two planes, so far as the current of air between them was observed. The box-kite was a very efficient and stable machine, but although it had come into great use he had always doubted whether it possessed any advantage over a single plane surface. He had not brought his models with him, because it was very difficult to show them in a crowded room, and also because they were very apt to be erratic. He intended to construct more models on the principle of the one to which he had referred in the paper, which he hoped to show at the meeting of the Aeronautical Society in July. The suction action on the back of the plane was a very important point, and this had just recently been investigated by Dr. Stanton, and it would be interesting to know the results he had obtained. Professor Bryan, a professor of mathematics, had recently given some lectures at the Royal Institution on the subject of aeroplanes in flight, discussing the subject from a mathematical point of view, and stating that it was necessary to discover mathematically how a machine should be balanced and then build a machine and try it, and that he did not care about risking his neck until that had been determined. Personally, he was afraid it would be a very long time before a machine was built by means of mathematics without practical tests. Mr. Reid had referred to the wing action of a bird as probably being more efficient than a screw propeller. He (the author) was not very much inclined, like some people, to imitate Nature in a slavish way. Birds had certain complicated actions, and it had often been suggested by some people that the biggest birds were the largest creatures that could be made to fly, and therefore that human beings would never be able to fly. A small bird flapped his wings very rapidly, and was able to easily rise directly off the ground; on the other hand, a large bird in almost all cases had great difficulty in doing so, having to flap his wings violently and make a great effort. He was inclined to think it was not necessary to imitate the bird at all, because birds had not anything to learn from insects in the way of flight, and in the same way he did not think a man had much to learn from a bird. He was in thorough agreement with the suggestion that experiments should be made over water, the few experiments he had made with large machines being conducted in that way. He was, at the present moment, arranging to make several big experiments over water, having been offered the use of a private lake in the country, where he hoped to do a lot of work in the summer. With regard to the question of

soaring birds, Langley's book, "The Internal Work of the Wing," threw a great deal of light on the possible solution of that question. In reply to Col. Cunningham's remarks, the experiment which he (the author) showed in connection with the exact point of balance was very important, from which it would be found there was a great difference whether the centre of gravity was at a point ·3, or ·33 of the distance from front to rear of the aeroplane. He noticed the rocket arrangement tried at the Alexandra Palace particularly, and noticed that the rocket was pointing downwards, which must drive the back up and the front down. With regard to the question of sailing birds, in his opinion, the most interesting part of the Exhibition at the Palace was Mr. Weiss's models similar to birds which soared down and looked exactly like soaring birds, travelling long distances with great steadiness. He considered that balloons were very dependent on the weather, and were difficult to manage and house. It was quite a fallacy for Dr. Scott Tebb to think that birds had air vessels in them which assisted in their levitation, the amount of air which they could get into their bones in such a way being such a minute quantity that it would hardly make any difference in their lifting power.

The CHAIRMAN, in proposing a hearty vote of thanks to Major Baden-Powell for his intensely interesting paper, thought the audience would be unanimous in coming to the conclusion that the problem of aerial navigation was a purely practical and not a mathematical one, and that it had not yet been perfectly solved. It was possible to take a little aneroid round a garden, and make a few experiments for oneself, while he had personally obtained an immense amount of information in the same way as to the variation of pressure on big bridges. On the front of a wall the needle pointed to a certain points, while at the back of the wall it pointed to an entirely different one, so that information was at once obtained as to the negative pressure at the back. If it was taken first to the weather side of a tree and then to the lee side, it would be found that the negative pressure was much smaller when a cylinder was being dealt with than when a flat plate was used. If it was used with an inclined plane, it would be found that the positive pressure at the edge on the underside was very much less than the negative pressure. How in the world any mathematical expression, even if one devoted one's whole life to it, could give the distribution of negative pressure on an inclined aeroplane he did not know. Fifteen years ago Lord Rayleigh told him that he had worked for two years before he succeeded in getting the positive pressure of a given velocity of wind on the face square to the wind. If one attempted to approach the subject mathematically in a practical way, it was perfectly hopeless; experiments with little pieces of paper such as the author used would give more information than years spent at mathematics. An aeroplane was navigated in a uniform fluid, but the problem was entirely different from that connected with submarines. There were vertical streams in the air of great velocity, which rendered it difficult to ensure getting an exact balance, although that might be obtained in still air. He thought there would always be a liability for the balance to be upset; and a margin of stability would be required in the construction of the machine which would give human agency the power of meeting those unexpected eddies.

The resolution of thanks having been carried unanimously, the meeting terminated.

SMALL HOLDINGS IN GREAT BRITAIN.

Attention has been drawn by the Board of Agriculture and Fisheries to the report of the Departmental Committee of Small Holdings (Cd. 3277), and in particular to the observations contained therein with respect to the present administration of the Small Holdings Act, 1892. This Act has been largely a dead letter, owing to the failure of County Councils to put its provisions into force. It may be gathered from the report of the Committee that Section 5 of the Act has been read as provided that the Small Holdings Committee of a County Council are not required to take any action until they receive a petition alleging that there is a demand for small holdings in a particular division of the county, and that the petition must refer to specific lands. The Committee point out that it is the duty of every Small Holdings Committee of a County Council to consider whether the circumstances of the county justify the Council in putting into operation Part I of the Act, and they suggest that in order to satisfy the requirements of the law in this respect, the Committee should on their own initiative make such enquiries as may be necessary to enable them to report to the Council. Under Section 5, every County Council is obliged to appoint a committee to consider whether the circumstances of the county justify the Council putting into operation Part I of the Act, but most of the County Councils beyond appointing this committee have done nothing more. The Committee has waited to receive applications, and in many cases none have been received, so nothing has been done. The Departmental Committee point out that so far all the Act requires is that the County Council shall get information to enable it to decide whether the circumstances of the county justify or not putting the Act in force in the county. If the Council finds in the affirmative, the next step is a petition from a county elector or electors praying that the Act may be put in force in some particular electoral division or divisions. The Act, as the Committee point out, does not expressly state this. It speaks of a petition praying that the Act may be put into force, but the next subsection making the local councillor or alderman

residing in the electoral division in which it is alleged there is a demand for small holdings, a member of the committee for considering the application, implies it. The next step is a reference to the Committee of the petition, and on their being satisfied of its being presented in good faith, and on reasonable grounds, an inquiry into the circumstances of the petition by the Committee, and a report on the result of the inquiry to the County Council. All these four steps are a necessary preliminary to any steps being taken under the Act to put Part 1 into force.

Among the recommendations of the Committee on the Small Holdings Act are the following:—

(*a*) That the purchaser shall pay down one-eighth instead of one-fifth of the purchase money.

(*b*) That the County Council shall have power to defer the payment of the instalments from time to time in such cases as they deem advisable.

(*c*) That power shall be given to County Conncils to acquire for small holdings purposes grazing rights other than those attached to any land acquired by a Council for sub-division.

(*d*) That an annual enquiry be made by each County Council Small Holdings Committee from the minor authorities within the county as to what land is occupied by small holders, whether there is a demand for further land, and whether there is any land available.

(*e*) That the attention of all County Councils should be called to the duty of their Small Holdings Committee to report as to why or why not the circumstances of the county would justify the council putting into operation Part 1 of the Act—the provision of small holdings. That petitions be received under Section 5 may be general, and need not refer to specific lands, and that the enquiry ordered under the same section of the sub-section need not be a public or local one

OUTDOOR ADVERTISING IN GERMANY.

Outdoor advertising displays are closely restricted in Berlin. Bill-boards are absolutely prohibited, but in place of such unsightly objects, public advertising is confined to a system of neat pillars or columns on the edge of the pavement at the principal street corners. These round hollow columns, called "Litfass Säulen," after the originator, are built substantially of iron and wood, about twelve feet high and three feet in diameter, the exterior having an advertising surface of from eleven to twelve square yards. The pillars are used principally for the advertisements of theatres and other places of amusement, for the announcements of papers and periodicals, and official notices. They are a conspicuous feature of Berlin street life, and are consulted regularly by theatre goers, &c. Much artistic ability is displayed in the arrangement of the differently-coloured posters, which are mostly in the form of reading matter, and not pictures. According to the American Consul-General in Berlin, that city advertised in 1901 for bids for the privilege of erecting and using these advertising columns within the limits of the city for the term of ten years, and the successful tenderers are paying an annual rental of £20,000, payable quarterly. According to the terms of the contract, the city covenanted not to grant a similar licence to anyone else. Newspaper kiosks, however, are permitted to have advertisements on their walls, consisting of wood, tin, iron, glass, &c. At that time there were seven hundred columns already erected, and the number was to be materially increased. The contractors were to erect them at their own cost, but both as to design and location the approval of the police authorities was to obtained, and they at once became the property of the city, all repairs and proper maintenance being performed by the contractors. The city has the right to use the interior of the columns for various municipal purposes, such as storing utensils for street cleaning and sand for use in the streets, for switch apparatus for public electric lights, and meters for electric street railways, &c. These columns, therefore, are provided with doors and locks, and the contractors have to keep the interiors properly ventilated and free of moisture. Each column must also have distinctly marked on the upper portion the number of the city district, and of the police station, the nearest sanitary station, the nearest accident station, and the nearest station. Delay in any payment, or violation or neglect of any condition on the part of the contractors, renders them liable to a fine up to £50, and may even cancel the lease. A bond for £2,500 was given for the fulfilment of the terms of the contract. The contractors have the exclusive right to use these places for advertising purposes, subject however to certain conditions. The rates for advertising, which are regulated by the Berlin authorities, are according to space occupied, varying from about fourpence halfpenny to two shillings and sixpence per day, the latter being for a space of nineteen by twenty-nine inches. For placards larger than that, the charges are in proportion. All placards must be approved by the police authorities before being exhibited. The contractors must keep a record of applicants for advertising spaces, and unless in cases of great urgency the applicants receive attention in their order. The city authorities have the right to demand at any time the free posting of such official notices as may be necessary, and for this purpose a special shade of red paper is used, and no private advertisements may, therefore, use that particular colour. The posting of bills on the pillars must always be done at such time as to cause the least possible interference with the street traffic. and is, therefore, usually done at night. Besides these "Litfass Säulen," the city of Berlin has also leased thirty "Urania" columns for advertising purposes for the annual rent of £780. These columns are somewhat more elaborate than the others, being solidly constructed of iron; the height is the same, but the interior is not used by the city.

They generally contain a large clock, various local official notices, and the advertisements slowly revolve behind glass windows. No promiscuous filling up of scaffolding on new buildings with advertisements is permitted in Berlin. The owner of a building may paint any exposed part of it with signs, or hang out signs, but permission must first be obtained from the police. At the present time multi-coloured, changing, electrically illuminated signs on the tops, and on the fronts of buildings and stores are very much in vogue, so that the business part of the city at night time is, here and there, dazzlingly brilliant. "Sandwich men" are occasinally seen in the streets of Berlin carrying boards, but this is regarded in Germany as a degrading form of labour, and consequently this kind of advertising is not much practised.

THE COTTON GOODS TRADE IN JAPAN.

In spite of the efforts of the Japanese to restrict the imports of cotton goods, and of the Japanese mills to control the home market, there were more cottons imported into the country during the first six months of 1906 than in the corresponding period of 1905, when there was a boom in the demand, caused by the war. To meet the national debt rigid economy is necessary on the part of the Government and the people, but with the rapid progress being made, more, and finer, cloth will be worn by the middle classes, and here is the opportunity of the foreign mills. Japan is making great strides in the development of her cotton industries, but is not building mills fast enough to control the coarse goods market in Manchuria and Korea, and also the demand for finer goods at home. It is the opinion of experts in Japan that in time, and probably very shortly, the coarse and medium grades of cotton goods made by Japanese mills will drive out all competition. They will also manufacture the finer goods, and they are endeavouring to build up a working force of highly-trained foremen, who in time would convert a larger portion of the working force into skilled operatives. In the meantime, every new factory established in Japan means a larger market for foreign goods, for with the increase of wealth caused by manufactures the needs of the people will increase, especially for foreign luxuries, fine cloth, &c., that they cannot make themselves, and any reduction in the importation of foreign cloths will be only temporary. In the first half of 1906, of the principal cotton goods, gray shirtings were brought into the country to the value of £364,000; sateens and velvets, £115,000; prints, £81,000; white shirtings, £79,000; drills £8,000, and duck £8,000. The abnormal imports of duck during 1905 (£178,000), caused by the war demand, as sails, uniforms, tent cloth, &c., have dwindled to small proportions, and in fact during the month of July, 1906, there was not a yard of duck of any kind imported. The market for drills is also rapidly shrinking, and is now unimportant. In these two articles there appears to be no prospect of much revival of business, as they are being made in sufficient quantities by the native mills. In a recent report to the United States Department of Commerce, by the Special Agent of that Department, it is stated that the Fugi Cotton Spinning Company at Tokyo and others, are now making drills to be khaki-dyed, and the uniforms of both officers and men of the army are now practically all made in Japan. The largest item in the cotton imporrs has always been gray shirtings. The close of the war caused an increased demand for this class of goods, and this demand still continues. There was a record importation in 1905 (£651,000); but for the first six months of 1906, the imports reached a value of £364,000, and for the month of July, 1906, alone, £129,000. This cloth is always 36 inches wide, and 50 yards long. It was formerly 40 yards, but is now usually made 50 yards. At the present time, there is a large demand for print cloth of all kinds. The demand that arose from the war has increased, and it is expected that more of this article will be imported than formerly. Of cotton sateens and Italian cloth, the demand is very good. The greatest proportionate demand during the first half of 1906 was, for cotton umbrella cloth. In 1899 not a yard of this cloth was imported. Immense quantities of flannel are now being turned out by the Kyoto Flannel Company, the Miye Spinning Company, and other cotton mills, besides a very large number of small weaving establishments. At present, the cotton flannel business in Japan appears to be overdone, and the demand is so slack that some of the mills are expected to close. There is at present not much demand in Japan for fancy cottons, fine dress goods, &c., but there is some business done at a profit in these articles. There is not much demand for imported dyed goods, the prints being more used on account of their cheapness. Like all Oriental nations, the Japanese prefer loose, flowing clothing, but they do not, as a nation, incline to the contrast of colours usually considered typical of tropical climate peoples. The Japanese dress very quietly. The babies are decked out in very gay colours, contrasts of purple, red, yellow, &c. The children wear mostly big patterns of "kasuri." This is the name given the large patterns of squares, blocks, lines, &c., and are mostly white patterns on a blue ground. Blue is a favourite colour in Japan, probably more so than any other single colour. The older they get, the more soberly they dress, and the men wear no loud colours. Black may be said to be the national colour in cloth, and the clothing mostly used is very narrow striped gray and black. The younger girls affect gay colours, and on holidays this is true of a large number of the people, but ordinarily the "daimio-jima" is the national costume. The name "daimio-jima," which means "daimio stripes," is said to have been derived from the fact that in olden times it was the distinctive dress of the Daimios. Next to the stripes, small white dots on a

blue ground seem in most common use. The higher and more wealthy classes still use silk for clothing, in fact its use seems to be extending rather than decreasing, owing probably to the increase of wealth *per capita*. There is also a good deal of imitation silk, silk and cotton mixtures, used especially for kimonos in daimio-jima. Woollen goods are being used in increasing proportion for clothing, especially underclothing, and this is a promising field for manufacturers. The majority of the poople dress in kimonos made of print cloth, and use chiefly the narrow 13 to 15 inch widths of print cloth, made in the native mills. These print cloths are made up in neat packages, tacked twice at each end, with attractive labels, and with a bunch of silk floss to match pinned to the front. They are in pasteboard cases in most instances. Some are sold wound up in a roll. For the better grades, there is also used a large quantity of the 30-inch imported print cloth, most of which is printed in Japan. The average Japanese buyer, whether wholesale or retail, is not very far-sighted. He buys goods on their appearance and feel, and not for their durability or wearing qualities. He goes to importing houses at Yokohama, or Kobe, looks at samples, and then orders so many cases, to be the same in appearance, but to be cheaper. The latter condition can only be obtained by lowering the quality, and this process is going on all the time. This is where some firms have lost ground. They either introduce the very best qualities whose prices are too high to meet the competition of others, or noticing the general tendency of the Japanese to buy close, introduce low-class goods, whose appearance is such that they do not attract the Japanese buyer. The common saying in Japan is that the American fine qualities are too high in price, and the cheap goods too poor. The English and Germans have reduced the production of attractive cheap goods to a science. Running cheap goods through hot calendar rolls, removing all filling threads, and putting up in neat bolts tacked neatly, attaching attractive labels, and carefully putting up in bales, are items that do not cost anything like it does to throw the goods out of the factory as fast as made, without a thought for their attractiveness to the buyer. The rough-finished, crumpled-looking goods may be made from better cotton, and more durable and lasting, but as compared with a smooth-finished, attractive looking article of really poorer wearing quality, they do not appeal to the buyer. More attention should be paid to the finish and method of putting up goods if a larger market is desired in Japan. In regard to trademarks or designs, simple pictorial marks, such as a dragon, butterfly, lotus, or something of the kind, is better than simple lettering, especially long words. This is for the reason that it is often translated into Japanese and long words are apt to be abbreviated. Pictorial representation will also catch the eye and be easily remembered. There is no prejudice against religious emblems, but the Imperial Chrysanthemum must not be used.

HOME INDUSTRIES.

The Malting Trade.—If it would be too much to say that the once flourishing and wealthy malting trade will soon be a thing of the past there can be no question that its present position and outlook are discouraging, and that no trade, or hardly any, has to face so many difficulties. It may be said of the malting trade that it is essentially a rich man's trade. The raw material has to be bought in large quantities, the credit given being exceptionally long. And it remains a private trade, for the unavoidable inequality of profits makes the business unsuitable for joint stock purposes, the public disliking to invest in companies which can only show widely varying returns. In other days the profits of the maltster were large, nowadays he finds it difficult to make any profit at all. The Fates seem to be fighting against him. The arsenic scare of some years ago was a serious blow to him, and though it was evanescent its effect upon him has been permanent and serious. The public demanded the most searching analysis, and specialists would report that arsenic was traceable, although in insignificant and quite harmless quantities, say, one seven-hundredth part of a grain in a pound of malt. But harmless as such a quantity would be it was sufficient to condem large quantities of malt, and to warrant and, indeed, compel his customers to throw on the maltster's hand large quantities of malt that had been delivered. The maltster has done everything that science can suggest to him to eliminate even the seven hundredth part of a grain, and this has involved large expenditure. He no longer uses coke as a fuel, or moderately priced coal, but the best coal to be got. He uses malt polishers that the skin of the malt may be freer from dust, and he resorts to expensive devices for the purification of the heated air. All this means addition to working expenses at a time when the margin of profit is steadily decreasing from other causes. Then he has to reckon with the decrease in the consumption of beer. Whatever may be the cause—and opinions differ widely—the fact is indisputable that the consumption of beer, *per capita*, in this country is steadily diminishing. Although the brewing trade is the last to benefit from good trade, the present trade activity has been sufficiently prolonged to send up the sale of beer if, as some contend, the shrinkage of recent years was due to trade depression. But it has not done so to any extent, and there would seem to be ground for the conclusion that the working classes, who consume most of the beer, are spending their money in other ways than drinking beer. This hits the maltster much harder than the brewer, for when the brewer's sales diminish he naturally ceases to purchase from the malster. He has his own production of malt to draw upon in the first instance, and he only goes to the maltster when that is exhausted. There are large brewers who during recent years, when sales have been falling, have not made a bushel

less of malt for their own use, but the decrease in their purchases from the maltster have been very large, so that he has to bear the heavier part of the loss consequent upon decreased demand. Then again, some of the large brewery companies have erected extensive maltings, and wherever this is the case the maltsters necessarily lose a big customer. Nor must it be forgotten that the use of substitutes, raw grain and other things instead of malt, is rapidly spreading among all but the highest class of brewers. Some of the maltsters have sought compensation for loss in the home market by paying more attention to the export trade, and a good deal of malt has been forwarded to Australia. But transit presents great difficulties, and it may be doubted whether much will come of this trade. Altogether the outlook for the maltster is not hopeful.

The Rating of Machinery.—Mention was made in these notes (in the *Journal* of August 25th, 1905) of the unsatisfactory state of the law as it relates to the rating of machinery, and it was said (September 8th, 1905) that the London Machinery League had been formed to bring pressure upon Parliament to amend the Act of 1840, or rather to enforce the intentions of Parliament when framing it, intentions baulked by the contradictory decisions of judges, and the varying readings of municipal authorities. Since the passing of the Act, machinery has not been rateable *per se*' but it has been decided that in valuing buildings (such as factories) certain kinds of machinery are to be taken into account in ascertaining the rateable value of the premises. Under the existing law the line between the kinds of machinery which are, and those which are not, to be taken into account in ascertaining the rateable value of a factory is one that it is practically impossible to draw with any approach to distinctness. The consequence of a lack of uniformity in the methods adopted by different rating authorities in valuing premises containing machinery which is not so fixed as to mean a part of the freehold works considerablein justice, and seriously handicaps manufacturers in districts where the rating authorities think only of how much they can plausibly exact. The Government have promised to deal with the matter, but prefer to wait until they take up the whole question of local taxation. To meet this difficulty the London and Provincial Machinery League, of which the Lord Mayor is president, have proposed a Suspensory Bill, which provides that in the valuation of premises containing machinery not fixed, or only so fixed that it can be removed from its place without necessitating the removal of any part of the premises, the value of such machinery is not to be taken into account, but this provision is not to be applied to any machinery or plant used for producing or transmitting a first motive power, or for heating and lighting the premises. The Bill is of a temporary character, intended to bridge over the period until the Government is able to deal with the matter. Its terms would only be in force until December 31st, 1908, by which time it is hoped that a permanent settlement will have been reached. Nor is it retrospective. Indeed, it specially provides that assessments in force at the date of the commenceent of the Act shall not be reduced by reason of its provisions. The promoters of the Bill have a very strong case. They only seek to do at once what two Royal Commissions, sitting at wide intervals of years, have reported ought to be done, and it may be hoped that the Government will adopt it.

The World's Production of Gold.—The yield of gold mines may not, at first sight, seem to have much to do with Home Industries, but in fact it has a very important bearing upon them. The *Statist* (April 13th) has an interesting series of tables covering the gold production of the world during the last century, and illustrating the sensational growth of the last twenty years. Figures compiled by Professor Soetbeer show that in the first decade of last century the production of gold averaged £2,288,000 per annum, and by 1850 the average of the decade had risen to £7,044,000, the gold being valued at £4 per ounce, and the weights taken at 32⅛ oz. to the kilogramme. In the later forties and fifties came the great American and Australian discoveries. In 1850 the value of the world's production, according to the United States' mint estimates, was £11,600,000; in 1851, £17,200,000; in 1852, £36,550,000. Then there was a falling off. In the thirty years—1860-90—the annual production did not vary more than five millions as an extreme, say between £20,500,000 in 1882 as the lowest and £25,400,000 in 1871 as the highest. In the middle of the eighties gold was first exported from the Transvaal. In 1882 the production of gold from South Africa, Rhodesia, and the West Coast was practically nil; then came the Transvaal discoveries, and in the nineties those of Western Australia and the Yukon, Klondike. In 1893 production increased to £32,600,000; in 1898, the year before the outbreak of the war in South Africa, it had reached £57,486,000, last year it was roughly 81,000,000. In other parts of the world than those named there was also increase in production. The combined production of Mexico, Columbia, and Brazil in 1882 was estimated at only about £900,000. Last year Mexico alone yielded £3,260,000, while Brazil and Columbia together gave about £800,000. Guiana, Peru, and other South and Central American States, exclusive of Mexico, gave for 1905 approximately £1,500,000. India too, in recent years, has made steady growth. At the present time the Transvaal heads the list or producers, its yield for 1906 being roughly £23,600,000. The United States came next, with £17,636,000, Australia coming close with £17,191,000. Even the West Coast of Africa is moving upwards. In 1880-83 it only produced £48,000 worth of gold; in 1901 the production had fallen to £22,000, but since then it has

steadily improved until last year it reached the respectable figure of £878,000. It looks as if for some years to come the increased output of gold from the Transvaal will be larger than elsewhere, and that probably within the next five years the total production of gold will reach £100,000,000 per annum. During the last sixteen years the annual production of gold has increased from £24,260,000, in 1890, to roughly £81,000,000, in 1906. The effect upon trade is, and will be, very great.

Electrical Railways—Considerable progress was made during the past year with electrical railways in the metropolis. The Baker-street and Waterloo tube was opened for traffic in March; the second of the tubes constructed by the Underground Electric Railways Company of London was opened in December; the conversion from steam to electric working of the Hammersmith and City Railway was completed; the Metropolitan Company withdrew all steam trains from the tunnel sections of their line north of Baker-street, and the year saw the almost entire abolition of steam working on what is known as the "Inner Circle." Is the cost of working any less by electricity than steam? As yet the data is too imperfect to answer this question. A train mile basis would be misleading, since it would take no account of the element of time. With steam, the booked time for a train to perform the journey round the Circle, was 70 minutes. Under electric working, and with automatic signalling, the time is reduced to 50 minutes. The cost of the energy required per mile may be more in the case of electricity, but the earning power of the line is increased, because it is possible to pass over a greater number of trains. Then in the case of a company owning its own generating station, the more current that is used within the capacity of the station the lower the cost per unit will be, since the fixed charges remain the same whether much or little current is used, while in the case of train running all additional trains involve a proportionate increase in expense. With regard to matters of construction, the respective merits of the third-rail system as adopted on the underground lines and the tubes, and the overhead system, which is preferred on the continent, continues to be discussed. There are those who predict that in the course of a few years the third-rail system will be obsolete, and it is, perhaps, significant that the Brighton Company has decided to use the overhead method in the electrification of certain sections of their line. This decision will enable a better comparison to be made between the rival systems. As to fares, again, opinion varies a good deal. The Baker-street and Waterloo Company have adopted the differential system, and at the recent meeting Sir George Gibb said the change had worked well. There has been a very large increase in the 1d. and 1½d. fares, and the company are now carrying nearly 57 per cent. of their passengers at fares below 2d.

NOTES ON BOOKS.

"WHAT I SAW IN THE TROPICS." *

The writer of this book is an American, a well-known authority on rubber, and the editor of the *Indiarubber World*, of New York. Mr. Pearson has made many visits to the chief rubber-producing countries, and gives much useful and up-to-date information upon this rapidly growing industry. A perusal of the book leaves the reader impressed with the profitableness of rubber cultivation, and its rapid extension in recent years. Mr. Pearson begins with Ceylon, where he was much struck, as all must be who visit the island, with the excellent work done by the Royal Botanical Gardens, Peradeniya, under the supervision of Mr. Willis. The oldest planting of *Hevea* is at Heneratgoda Gardens, which is one of the Government gardens under the direct charge of Mr. Willis. It is here that the first successful planting of Para rubber occurred, and it is due to Mr. Willis and his assistants that we have any sort of knowledge of the growth and productiveness of the *Hevea* tree under cultivation. Their work dates back to 1876, under Mr. Thwaites, when 7,000 seeds sent from the Amazon to Kew Gardens, were set out, only 4 per cent. of them germinating. From Kew, about 2,000 plants were sent out in Wardian cases to Ceylon, and 90 per cent. reached the Gardens in excellent condition. These were set out in bamboo pots, and flourished almost from the beginning, but the planters had set their hearts on the *Ceara* tree, and paid little attention to the reports that the director of the Gardens made from time to time as to their growth. In 1897, forty-five trees that stand about 30 feet apart, and were then twenty-two years old, were messured at about 5½ ft. from the ground. The largest tree was 7 ft. 5 in., the smallest 2 ft. 1 in., the mean girth being 4¾ ft. From the Gardens in question, between three and four million Para seeds have been sent out to planters all over the Eastern tropical world, a wonderful practical piece of work, and one for which the tropical planter should be very thankful. Mr. Willis told Mr. Pearson that there were about 11,000 acres of *Hevea* plantings in the island, and as the annual production of seeds was about three millions, he thought the planting increase would be about 5,000 acres annually. The *Hevea* can be planted in sheltered valleys, up to 3,000 ft. altitude.

The rubber landed in Colombo costs 16 cents a pound, and Mr. Pearson gives estimates to show that fine Para rubber from Ceylon is very much more profitable to the grower than from the Amazon. In the one case he makes the planter's profit 1·03 dols., in the other only 0·56 dols. He admits, however, that the cost figures are very small, and that 20 cents a pound for cost in Ceylon would be nearer the mark,

* "What I Saw in the Tropics." Henry C. Pearson. The India Rubber Publishing Company, New York. London Agents, Arthur Wheeler and Co., Temple-chambers, E.C.

while Para rubber costs, landed in Para or Mandos, from 40 to 50 cents a pound. The care which the planters are expending upon the preparation of the rubber is the best sort of guarantee that the quality will be sustained. It may be interesting to describe the process carried out at a rubber-curing house of the best kind in Ceylon, where the milk is coagulated and the rubber prepared for market. This is a one-story brick building, 30 feet by 80 feet. At one end of the room is a long table upon which are hundreds of enamelled iron pans holding about one quart each. Into these pans the milk is poured through a cheese-cloth strainer after being previously strained in the field. To it is often added a very little acetic acid. This is allowed to stand over night, and in the morning there is to be found in each pan a pure white pancake of rubber, soft, spongy, and full of water. Each cake is rolled on a zinc-covered table with a hand-roller and much of the water thus expressed. The name of the estate is then stamped upon it with either a wooden or metal die, when it is ready for the heater room.

The heaters used are simply charcoal ovens, the ovens being spread on wire screens above the fire and left for three or four hours. By this time the pancakes have lost about 50 per cent. in weight, and are beginning to assume a darker hue. Cakes in this condition, if in South America, would be immediately marketed, but not in Ceylon. From the heaters they go to drying racks, where they are air-dried for a month or six weeks, the time depending somewhat upon the weather, and are shipped only after careful examination as to quality and dryness. The planter has to reckon with the risk of disease, and he is continually on the look-out for the appearance of it in the rubber, but intelligence and vigilance keep it under control.

The tapping of the trees begins just as soon as it is light in the morning, for through the middle of the day the *latex* does not flow freely, but starts up again about four o'clock in the afternoon, and is continued until dark. The trees are tapped when they show a girth of two feet, without regard to their age. No ladders or supports are used in tapping, as it is not found profitable to tap higher than a coolie can reach while standing on the ground. The tool is a very simple V-shaped knife with two cutting edges, and a single slanting cut about eight inches long has been found to be best, a tin cup being placed under the lower edge of the cut, and held in position by forcing its sharp edge under the bark. These cuts, by the way, are about a foot apart, sometimes closer, and all run in the same direction, the herring-bone and the V-shaped cuts being no more in evidence. The practise is also followed now of cutting a very thin shaving from one side of the cut every other day, eleven times; in other worde, re-opening instead of tapping. Before placing the tin cup under the cut, it is rinsed out in cold water to keep the *latex* from adhering to the tin, and also to keep it from too quick a coagulation. Experiments in scraping the dry bark from the trees have been very successful. Such stimulation to the lactiferous ducts stimulate the flow nearly 50 per cent. Some of the oldest trees, say 18 years, which gave an average of 3 lbs. a year, by scraping the dry bark doubled the output.

Mr. Pearson visited not only Ceylon and the Federated Malay States, but Mexico, Nicaragua, Costa Rica, Panama, Columbia, Jamaica, and Hawaii. He seems to be much impressed with the rubber-producing capacity of Mexico. Here the rubber tree is free from pests. In Mexico the *latex* flows apparently as freely at one time of the year as at another, but the dry season is the best for tapping as there is no rain to wash away the milk and the tree is resting then. Of the various means of coagulating that are devised by experts, the one that seems to appeal the most strongly to the Mexican planter is the use of juice of the "Amole" vine, the *Ipomoea Bona Nox*, which is abundant everywhere, and which apperently adds nothing to the rubber, and effects a quick and clean coagulation. The planter must be alert and careful in preparing his ground, and especially in getting his seed into the ground at the right time so that it shall have the proper start. Mr. Pearson seems to think that a considerable cultivation of rubber is possible in Jamaica. At the Hope Gardens, near Kingston, the *Hevea* and *Castilloa* are couspicuous. The former does not seem to be well at all, as it is spindling in its growth, and far from vigorous, but the *Castilloa* looked much more promising. It may not be generally known that Jamaica has its own rubber producer, a climbing shrub known as Milk Witte. Its botanical name is *Forsteronia floribunda*, and its stem yields a rubber which as long ago as 1891 was valued in England at over 3s. a pound. It is a good grade of rubber, and the *latex* is said to be very rich in caoutchouc. There can be little doubt that the profits now being got for the cultivation of rubber are encouraging planters all over the tropical world, wherever there is the conjunction of proper soil, climate, and cheap labour to engage in rubber cultivation. In Ceylon it is supplanting tea cultivation much as tea supplanted coffee. Even the Japanese are preparing to plant rubber in Formosa.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

APRIL 24.—"The Cultivation of India Rubber." By HERBERT WRIGHT, Controller of the Government Experimental Station, Ceylon. LIEUT.-COL. DAVID PRAIN, C.I.E., F.R.S., will preside.

MAY 1.—"The Defence of the Sea Coast from Erosion." By ALFRED EDWARD CAREY, M.Inst. C.E.

MAY 8. — "The Production of Coke and its Application in Domestic Fires," By PAUL SCHLICHT. CORBET WOODALL will preside.

MAY 15.—"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 2.—"The Applicability to Indian Rivers of the Italian System of Dealing with Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricultural Department.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

APRIL 23.—"Social and Economic Conditions in Australia." By the HON. JOHN WINTHROP HACKETT, LL.D.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON. J. C. WEDGWOOD, M.P., will preside.

∴ A collection of examples of lustre pottery from the Victoria and Albert Museum, and from private owners, will be arranged to illustrate Mr. Burton's paper, and will be on view during the afternoon and evening of the day of the meeting.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

LECTURE II.—APRIL 22.—The alkalies used in laundry work—Their relative values and useful strengths—Bleaching agents—their composition and properties—Methods of applying bleaching agents—Their comparative value—Dangers in the use of bleaches—Methods of valuing bleaches.

LECTURE III.—APRIL 29.—The problem of washing—Textile fabrics: easy methods of distinguishing between them chemically and by the microscope—Shrinkage of woollen goods—Behaviour of various fabrics with detergents and bleaching agents—Influence of acids, alkalies, &c., on the individual fibres—Precautions to be observed.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 22...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Prof. Herbert Jackson, "Detergents and Bleaching Agents used in Laundry Work." (Lecture II.)
Surveyors, 12, Great George-street, S.W., 4 p.m. Discussion on Mr. Leslie S. Wood's paper, "The Improvement of our Woodlands."
British Architects, 9, Conduit-street, W., 8 p.m.
Medical, 11, Chandos-street, W., 8½ p.m.
Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Professor Sir William Ramsay, "Exploration in Asia Minor, as bearing on the Historical Trustworthiness of the New Testament."

TUESDAY, APRIL 23...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Colonial Section.) The Hon. J. W. Hackett, "Social and Economic Conditions in Australia."
Royal Institution, Albemarle-street, 3 p.m. Professor W. Stirling, "Stimulation, Luminous and Chemical." (Lecture I.)
Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. P. Allan's paper, "The Pyrmont Bridge, Sydney, N.S.W." 2. Mr. W. H. B. Savile, "Swing Bridge over the River Avon, at Bristol."
Photographic, 66, Russell-square, W.C., 8 p.m. Messrs. E. J. Wall and C. P. Butler, "The Spectroscope." (Part II.)
Zoological, 3, Hanover-square, W., 8½ p.m.
Antiquaries, Burlington-house, W., 2 p.m. Annual Meeting.

WEDNESDAY, APRIL 24...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Herbert Wright, "Rubber Cultivation in the British Empire."
United Service Institution, Whitehall, S.W., 3 p.m. Captain G. A. Charrier, "Bonaparte's Campaigns in Italy—1796."
Royal Society of Literature, 20, Hanover-square, W., 4½ p.m.
British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, APRIL 25...Royal, Burlington-house, W., 4½ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. W. Verrall, "Euripides and his Age." (Lecture I.)

FRIDAY, APRIL 26...Royal Institution, Albemarle-street, W., 9 p.m. Mr. James Swinburne, "New Illuminants."
Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Buttons and Clasps."
Botanic, Inner Circle, Regent's-park, N.W., 4 p.m.
Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Address by the President.
Clinical, 20, Hanover-square, W., 8½ p.m.
Physical, Royal College of Science, Imperial Institute-road, S.W. 1. Mr A. E. Garrett, "Electrical Conduction Produced by Heating Salts." 2. Mr. W. S. Tucker, "The Influence of Pressure upon Convection Currents, and a Criticism of J. Stark's relation between Cathode fall of Potential and Temperature." 3. Mr. W. B. Croft, "Solenoids which are Turned by the Earth's Magnetic Field." 4. Mr. J. A. Tomkins, "Simple Apparatus for Mechanically Illustrating the Tangent and Sine Laws."

SATURDAY, APRIL 27...Royal Institution, Albemarle-street, 3 p.m. Prof. Sylvanus P. Thompson, "Studies in Magnetism." (Lecture III.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

MONDAY, APRIL 29, 8 p.m. (Cantor Lecture.) PROF. HERBERT JACKSON, "Detergents and Bleaching Agents used in Laundry Work." (Lecture III.)

TUESDAY, APRIL 30, 8 p.m. (Applied Art Section.) WILLIAM BURTON, F.C.S., "Lustre Pottery."

*** A Collection of examples of Lustre Pottery from the Victoria and Albert Mnseum and from private owners will be arranged to illustrate Mr. Burton's paper, and will be on view during the afternoon and evening of the day of meeting.

WEDNESDAY, MAY 1, 8 p.m. (Ordinary Meeting.) ALFRED EDWARD CAREY, M.Inst. C.E., "The Defence of the Sea Coast from Erosion."

THURSDAY, MAY 2, 4.30 p.m. (Indian Section.) SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., "The Applicability to India of the Italian Method of Utilizing Silt."

Further details of the Society's meetings will be found at the end of this number.

SAMPLES OF INDIA RUBBER.

A Collection of Samples of India Rubber, principally Colonial, arranged by Messrs. Edward Till and Co., was exhibited on Wednesday evening, 24th inst., in illustration of Mr. Herbert Wright's paper on the "Cultivation of India Rubber." The collection can be seen on Friday from 10 a.m. to 4 p.m., and on Saturday from 10 a.m. to 1 p.m. Admission by member's order, or on presentation of visiting card.

CANTOR LECTURES.

On Monday evening, 22nd inst., PROF. HERBERT JACKSON, F.I.C., F.C.S., delivered the second lecture of his course, on "Detergents and Bleaching Agents used in Laundry Work."

The lectures will be published in the *Journal* during the summer recess.

COLONIAL SECTION.

Tuesday afternoon, April 23; the HON. ALFRED DEAKIN, Prime Minister of the Commonwealth of Australia, in the chair. The paper read was "Social and Economic Conditions in Australia," by the HON. JOHN WINTHROP HACKETT, LL.D.

The paper and report of the discussion will be published in a future number of the *Journal*.

PROCEEDINGS OF THE SOCIETY.

EIGHTEENTH ORDINARY MEETING.

Wednesday, April 24, 1907; LIEUT.-COLONEL DAVID PRAIN, C.I.E., F.R.S., Director of the Royal Botanic Gardens, Kew, in the chair.

The following candidates were proposed for election as members of the Society:—

Evans, J. W., Cobalt, Ontario, Canada.
Lee, William Harold, Sudan Railways, Shendi, Egypt.
Madunji, Pandoorung, 925, Bhandarwada-road, Dadur, Bombay, India.
Muntri, Narayen Govindjee, 192, Worlee-road, Bombay, India.
Rule, Thomas, Oceana Consolidated Co., Ltd., Kaombi, Chiromo, British Central Africa.
St. Quentin, F. G. de, British Consulate, Prague, Bohemia.

The following candidates were balloted for and duly elected members of the Society:—

Broadbent, Denis Ripley, A.M I.E.E., A.M.I.M.E., Royal Societies Club, 63, St. James-street, S.W.

Davies, Henry A., The Hawthorns, Bradley, near Bilston, Staffordshire.

Edwards, Mrs. Helen Agnes, Flat C, Artillery-mansions, Victoria-street, S.W.

Fryer, Sir Frederic William Richards, K.C.S.I., 23, Elvaston-place, S.W.

Jayakar, Balaji Jagonnath, 41-43, New Wadi, Bombay, India.

Khaw Joo Tok, Penang, Straits Settlements.

Khoo Eu Yong, Penang, Straits Settlements.

Kirkham, Captain John Karkeek, Fontabello, Barbadoes, British West Indies.

Leckie-Ewing, William, Rupurara, Inyanga, Rhodesia, South Africa.

Lim Eu Toh, Penang, Straits Settlements.

Lim San Ho, Penang, Straits Settlements.

Lim Tek Suan, Penang, Straits Settlements.

Mackenzie, R. R., Belgaon Tea and Fibre Co., Ltd., Chittagong, India.

O'Conor, James Edward, C.I.E., Francesco, Church-road, Upper Norwood, S.E.

Ong Hun Chong, Penang, Straits Settlements.

Osborn, Lieut.-Colonel Philip Barlow, D.S.O., Zomba, British Central Africa.

Sarkar, Chandra Kumar, 31, Penang-street, Moulmein, Lower Burma.

Thio Siow Kong, Penang, Straits Settlements.

Thio Tiauw Siat, Penang, Straits Settlements.

Thomson, Sir James, K.C.S.I., M.A., Pea Hen Hotel, St. Albans, Herts.

Yeoh Ooi Gark, Penang, Straits Settlements.

The paper read was—

RUBBER CULTIVATION (WITH SPECIAL REFERENCE TO PARTS OF THE BRITISH EMPIRE).

By Herbert Wright.

The cultivation of rubber-yielding plants has been brought prominently before the public during the last few years, and has aroused considerable interest. At the present time almost every institution concerned with tropical products is directing its attention to rubber-yielding plants, and recent developments in Ceylon, Southern India, Malaya, and other parts of the world, appear to have presented an opportunity of an unparalleled type to the investing public. It is necessary to consider the potentialities of this tropical industry and to determine its present and future importance from the producer's standpoint, especially in British possessions.

Development of the Rubber Market.

The stimulus which has been given to the exploitation of wild rubber and the establishment of plantations is evident from a consideration of the figures showing the consumption and value of rubber during the last few years; the increase in value from about three to over five shillings per lb. has been encouraging to rubber planters, and the increase in consumption, as shown in the figures kindly furnished by Messrs. Hecht, Levis, and Kahn, has inspired confidence in all concerned. Furthermore, the developments in the past few years on Eastern plantations have shown that yields are obtainable which were once considered impossible, and the expenditure incurred in collecting and preparing the rubber is rapidly being brought near the minimum:—

Year.	World's consumption of rubber.	Range in value of fine Para, per lb.	Prices paid for some samples of plantation rubber.
	Tons.	s. d. s. d.	s. d.
July, 1899, to June, 1900..	48,352	3 8½ to 4 9½	4 0
July, 1900, to June, 1901..	51,136	3 6 to 4 4½	4 1½
July, 1901, to June, 1902..	51,170	2 11¼ to 3 11½	4 0
July, 1902, to June, 1903..	55,276	2 10¼ to 4 1½	5 0
July, 1903, to June, 1904..	59,666	3 9 to 4 11	6 0
July, 1904, to June, 1905..	65,083	4 5 to 5 9	6 8
July, 1905, to June, 1906..	62,574	5 0¾ to 5 8	6 3

Rubber, Gutta, and Balata.

The relative importance of the india-rubber, balata, and gutta percha industries is indicated in the following figures*:—

Annual Exports of India Rubber, Gutta Percha, and Balata. Average for Years 1901, 1902, 1903.

	Totals.	
Rubber	973,000 cwt. ..	£12,537,000
Balata	50,000 ,, ..	£387,000
Gutta	220,000 ,, ..	£2,014,000
	1,243,000	£14,938,000

The gradually increasing demand for raw rubber, the remunerative prices at present paid for it, and its relative importance among the products of the tropical world, are all that we can reasonably desire, and under

* Atlas of the World's Commerce, Part 7, 1906.

these circumstances we may naturally expect to see a fair amount of capital invested in many islands and territories in the tropical zone. It will be shown later how the "wild" rubber has been practically the only source in the past; the promising importance of plantation and semi-wild rubber has apparently, as far as many English capitalists are concerned, been more attractive, and a statement of the sums invested in notable properties will best serve our purpose.

PAID-UP CAPITAL OF RUBBER-PLANTING COMPANIES.

	£
Malay	2,048,281
Ceylon and India	415,213
Islands in Indo-Malayan region	651,123
America	765,000
Africa	430,000
Sterling equivalent of capital existing in Rupee and other local currency in:—	
Malay	532,748
Ceylon and India	370,566
Islands in Indo-Malayan region	28,333
Companies growing rubber in conjunction with tea, cacao, and other products	9,121,761
Grand total	£14,363,325

These figures, kindly furnished in March, 1907, at my request by Mr. Fritz Zorn, show about five-and-a-quarter million sterling, invested in rubber alone, an amount which is being daily increased, and one which, if viewed in the light of the premiums at present obtainable for many of the shares, is considerably higher than the sum quoted here. It should also be remembered that only the paid-up capital is here dealt with, and that since the figures were compiled, other companies have been successfully floated in England.

You will observe that, in the foregoing table, only those companies registered in Great Britain, Ceylon, India, and Malaya have been taken into account. English capital has also been invested in the cultivation and exploitation of rubber in numerous East and West Indian islands, in tropical America and Africa, and very large sums from Continental areas have been supplied for the same purpose. These have been entirely omitted in the figures given in this part of the paper.

As most of you are aware the shares of many concerns, now prominently before the public, are standing at very high premiums, representing, in many cases, from three to eight times the paid-up capital; there are numerous semi-public and private properties in the Indo-Malayan region, about which little can be at present divulged; numerous cacao, tea, and coffee estates are gradually but surely being supplanted by rubber-producing species; large areas are being daily alienated for rubber; forests, with indigenous rubber plants, are being exploited under scientific guidance; and almost every tropical institution has turned its attention to this seemingly profitable cultivation. But neglecting all these side developments, it may be safely stated that to-day there are no less than fourteen million pounds of English money represented as paid-up capital, in companies directly or indirectly concerned with rubber-growing, and registered in England and our East Indian possessions. Furthermore, it may be estimated that approximately £30,000,000 worth of rubber may be consumed during the present year. These facts, though indicating that large sums of money have been vested in the production and utilisation of rubber, are insignificant compared with developments which are at the present time in an embryonic stage. Nevertheless, they show that the cultivation and exploitation of rubber plants have to be taken seriously, and, barring unforeseen developments, we may expect the final result to be such that British possessions in the tropics will be placed in the front rank as producers of plantation rubber.

SOURCES OF RUBBER.

Having seen that the consumption of rubber is on a sufficiently large scale to lead to the investment of several million sterling in its exploitation, it now becomes necessary to deal briefly with the sources of production. The most striking feature is the almost absolute dependence, to-day, of the manufacturers on the rubber obtained from trees indigenous to certain tropical forests and their independence of the plantation product. It is necessary to point out that tropical America is the most important centre for rubber collection (about 60 per cent.), tropical Africa the next (30 to 35 per cent.), and tropical Asia the least important, since it only contributed, last year, a very small proportion (about 3 per cent.), made up of wild and plantation material. It is of interest to recapitulate that the richest wild rubber areas in tropical America (Brazil, Venezuela, Bolivia, Peru, Central America, and Mexico), and in tropical Africa (Congo Free State) are not British, though capital

from this country has been recently diverted to parts of these two vast continents for the exploitation of rubber.

Tropical America.—In tropical America the only British possessions of much importance are British Honduras and British Guiana. British Honduras is a colony on the east coast of Central America, having 90 square miles out of a total of 7,562 square miles under cultivation. *Castilloa elastica* is described as occurring near the rivers Belize, Sibun, and Mullins. The colony produces very little rubber at the present time, and that only from wild trees near the coast; the available statistics* show a gradual decline in the export of this produce:—

EXPORT OF RUBBER.

Year.	Weight in lbs.	Value in dollars.
1901	40,044	23,237
1902	30,338	14,163
1903	22,176	13,002
1904	28,042	18,262
1905	22,926	15,921

The Statistical Abstract † shows only 20,111 lbs. exported, valued at £2,815, for British Honduras in 1905.

British Guiana, which is a portion of the South American Continent, though bounded on the east, south, and west by Dutch Guiana, Brazil, and Venezuela respectively, is not so much noted for its rubber export as for its "Balata," and under the heading of "Rubber Production" for that country, the Statistical Abstract for 1906 gives the following, without distinguishing the small quantity of rubber from the large quantity of balata:—

Year.	1895.	1900.	1905.
Quantity in lbs.	159,524	425,571	497,829
Value in Sterling	£8,923	£19,585	£41,487

* Colonial Report, No. 515, British Honduras, 1905.

† Statistical Abstract for the several British Colonies, Possessions, and Protectorates, 43rd No., 1906.

Tropical Africa. — In tropical Africa—though British possessions concerned in exporting or collecting rubber do not compare very favourably with the Congo Free State and other areas—there are indications of wide-spread activity from the most northerly districts of the West Coast to Natal in the south-east of that Continent. The following figures* show the changes during recent years in British rubber-producing areas in Africa:—

Country.	Quantity in lbs.			Value in Sterling.		
	1895.	1900.	1905.	1895.	1900.	1905.
British Central Africa Protectorate	563	86,404	17,280	28	9,332	2,160
Uganda Protectorate	—	—	101,164	—	—	13,305
British East Africa Protectorate	104,850	100,600	144,032	8,192	10,060	18,929
Protectorate of Southern Nigeria	308,309	2,251,315	2,842,831	11,787	137,289	226,387
Colony of Southern Nigeria (Lagos)	5,069,577	596,332	274,144	269,893	48,239	23,791
Gold Coast	4,022,385	3,452,440	3,687,778	322,070	328,156	323,774
Sierra Leone	1,429,680	274,624	426,610	86,940	25,741	49,132
Gambia	—	—	9,071	—	—	915

In British Central Africa the cultivators are encouraged to plant rubber vines and trees; there is no export duty on cultivated rubber,† but one of 4d. per lb. is levied on all rubber from wild plants. There are, at present, about 850 acres cultivated with *Ceara*, *Landolphia*, *Castilloa*, and other rubber-yielding species, the large cultivated properties being in the Blantyre and Zomba districts. It is stated‡ that very little rubber is now obtained from the Protectorate itself, and the following details are given in the Colonial Report for 1905-6:—

Year.	Crop exported to 31st March of each year. (lbs.)	Valued at £
1898	21,416	1,059
1900	118,720	13,356
1902	14,393	1,619
1904	4,262	426
1906	17,283	2,160

In the Uganda Protectorate there has been a renewal of interest and activity in the collecting of rubber from wild trees owing to the discovery of large numbers of valuable trees and vines in local forests. In the Mabira Forest, Uganda, Dr. Cuthbert Christy esti-

* Statistical Abstract for the several British Colonies, Possessions, and Protectorates, 43rd. No., 1906.

† Colonial Report, No. 499, B.C.A. 1905-6.

‡ "Bull. Imp. Inst.," London, Vol. IV., No. 4, 1906.

mates that in an area of about 54 square miles there are approximately 1,760,000 rubber trees; the value of this and other important statements will be discussed shortly.

In British East Africa, under whose administration all the Uganda provinces east of Lake Victoria were placed in 1902, large areas of land have been leased to rubber collectors, chiefly Indian and Arabian, and numerous experiments are now being made with indigenous and introduced rubber-yielding species, near Mombasa. According to one authority, the chief rubber areas* are (1) Coast strip, running from 5 to 20 miles inland; (2) Kitui area; (3) Laitokitok; (4) Ravine; (5) Kamasia; (6) Nandi; and (7) Lumbwa. The same authority states that there is a 10 per cent. export duty on rubber, and that the amount exported during 1905 was valued at approximately £15,000.

In Northern Nigeria small areas are now being planted with rubber, and recommendations have been put forward advising that large plantations containing the best kinds of rubber plants should be established without delay. In the year 1905-06 rubber formed nearly three-fourths or 68 per cent. of the total value of the exports, but regret has been expressed at the destruction of rubber vines occasioned by the methods of collecting commonly practised. According to the latest report† "an Ordinance has been evolved, the principle of which is to hold the purchaser responsible that no *root* rubber is bought or exported. It, however, appears difficult to distinguish between rubber prepared from the root and that from the stem, and it is now under consideration whether the latter should not also be prohibited."

The large export from Lagos in 1895 has been attributed to the introduction of natives experienced in tapping, from the Gold Coast. There has, however, been a decline in the exports during recent years from the Gold Coast itself, and it is hoped that this will soon be remedied. The export of rubber from Sierra Leone in 1905 was equal to 11·27 per cent. of the total exports for that country, and was exceeded, in proportionate value, only by palm kernels and cola nuts. According to the Statistical Abstract, 1906, "in Sierra Leone an Ordinance has passed the Legislative Council which provides for the prohibition of the exportation of root rubber from January 1st, 1907." Gambia shows in its export for 1905 a considerable fall, the previous year being responsible for 30,934 lb. of rubber valued at £2,446.

* Leaflet No. 14, Nairobi, Dept. of Agr., B.E.A.

† Colonial Report, No. 516, Northern Nigeria, 1905-06.

In North-Eastern Rhodesia, in Natal, and in the Soudan, rubber is still of considerable interest. In Natal, probably the most southernly point for rubber production in Africa, the Government some time back offered to lease the rights of rubber-collecting over immense areas for a period of five years. The Soudan was once largely indebted to the rubber industry as a source of revenue, but bad methods of collecting have evidently been adopted with disastrous results; a concession for extracting rubber in Abyssinia has been granted by Emperor Menelik.

Sufficient has been said to show that rubber vines and trees are distributed throughout many parts of Africa and America. The relative insignificance of our exports from British possessions in the West Indies and the Indo-Malayan regions is obvious from the following:

West Indies.—In the West Indian islands the cultivation of rubber-producing plants is not in a very advanced state. There is only one indigenous climbing plant of note, and the main experiments appear to have been with trees of *Castilloa elastica* and rubber trees as shade in association with cacao trees. In 1902 Jamaica exported about 230 lbs. of rubber; in 1903 Bahamas exported 84 lb.; Trinidad and Tobago exported in 1905 9,394 lb., valued at over £1,200. At the present time many experiments are being made with tropical American and African species in Trinidad, Tobago, Dominica, Jamaica, and St. Lucia, and the results will be detailed elsewhere.

Eastern Countries. — The Indo-Malayan region, which includes Southern India, Ceylon, Burma, Malaya, New Guinea, Borneo, &c., is at the present time one of great activity, and, though the past exports have not been by any means very large, much is expected from this area in the near future. There are several indigenous species of known value, but the future developments probably lie mainly in the cultivation of species from tropical America. The figures of export given below indicate the present insignificant position of our Eastern possessions as producers of rubber.

India.—In the year 1905-06 the export showed a further advance on that for 1904-05

* India Office Records, London, 1906.

by 40·6 per cent., and attained a total value of Rs. 12·82 lakhs; this refers mainly to wild rubber.

	1900 01.	1901-02	1902-03.	1903-04.	1904-05.
	cwt	cwt.	cwt.	cwt.	cwt.
Bengal	3,280	2,223	700	1,226	2,349
Burma	4,409	1,913	335	566	1,871
Total Export	7,698	4,136	1,035	1,792	4,220
Value in Sterling	£103,180	£40,280	£9,410	£23,146	£60,784

Ceylon and Malay States.—The following are the exports of plantation india-rubber from Ceylon and the Malay States for the last two years:—

	Ceylon.	Malay States.	Total.
1905	70 tons	75 tons	145 tons
1906	160 ,,	350 ,,	510 ,,

The export from Ceylon during 1906 does not represent that island's present producing capacity; about 80,000 lb. were re-exported from the Straits, and about 9,500 lbs. from China.

Ceylon.—The following figures show the development in the exports of plantation rubber from Ceylon:—

Year.	Approximate Quantity Exported.
1900	73 cwt.
1901	66 ,,
1902	189 ,,
1903	389 ,,
1904	676 ,,
1905	1,401 ,,
1906	3,200 ,,

New Guinea, Borneo, &c.—British New Guinea, in 1902, exported 12,983 lbs. of rubber, valued at £1,435, but during 1905 the collection of rubber was prohibited for the greater part of the year, and the total export was only 590 lbs., valued at £67. The rubber is obtained from indigenous species, but in 1905 and 1906 Ceylon sent a large number of other species to the authorities in New Guinea.

Borneo has long been known for the export of rubber obtained from indigenous species, and numerous estates have already been taken in hand in consequence of results obtained with tropical American plants. The planted acreage is rather small, but mature trees of *Hevea brasiliensis* are already known in that island.

The Seychelles, Fiji, New Caledonia, and other islands in the East, are also developing a strong interest in rubber-producing plants; as countries of export they may be largely neglected in this paper.

BOTANICAL SOURCES OF CAOUTCHOUC.

The fact that out of a total rubber export of about 65,000 tons for 1906, no less than about 38,000 tons came from tropical America, and about 17,500 from tropical Africa, compels us to look to these two great continents for the majority of the caoutchouc-yielding plants, and to place the whole Asiatic or Indo-Malayan region in a minor or third position of importance. Our first duty is to see which plants provide the caoutchouc in each area, and to trace the distribution of notable species from one country to another.

The natural order which has furnished, and which still supplies, the greater part of the world's rubber, is the *Euphorbiaceæ*; the valuable species of *Hevea*, *Manihot*, *Sapium*, *Micrandra*, and *Euphorbia*, which it comprises are indigenous mainly to the tropical American region, but have been distributed to all parts of the tropical world. Next in importance, perhaps, is the *Apocynaceæ*, remarkable in tropical Africa for the valuable rubber species of *Landolphia*, *Funtumia*, *Clitandra*, *Mascarenhasia*, *Carpodinus*, &c.; this order also comprises the genera *Chonemorpha*, *Xylinabaria*, *Tabernæmontana*, *Melodinus*, *Alstonia*, *Hancornia*, *Urceola*, *Willughbeia*, *Parameria*, *Diplorhynchus*, *Forsteronia*, *Leuconotis*, *Ecdysanthera*, *Micrechites*, known in many parts of the tropics for the quality of rubber they yield.

The *Urticaceæ* is also of importance in tropical America for the species of *Castilloa*, and for the genera *Ficus* and *Artocarpus* in parts of Africa and the Indo-Malayan region.

The *Asclepiadaceæ*, though it possesses such a large number of laticiferous species, abundantly distributed, especially in tropical Africa, is remarkable for the absence of good caoutchouc-yielding plants; true, the genus *Cryptostegia* in Madagascar and India furnishes us with a small quantity of caoutchouc, but the other important genera such as *Calotropis*, *Cryptolepsis*, *Marsdenia*, and *Cyanchum*, have not yet been found to yield latices of high commercial value.

Perhaps the most remarkable natural order in this respect is the *Compositæ*; though it is represented by such a large number of species and is to be observed in almost every part of the world, there are hardly any of value to the cultivator of caoutchouc plants; during the last few years, however, there is one member of this group—*Parthenium argentatum*, A. Gray—which has come to be regarded as the source of Guayule rubber

in Mexico, and another—a species of *Hymenoxys*—as the source of Colorado rubber. *Sonchus oleraceus, L.*, has also been mentioned by Jumelle as yielding caoutchouc of value.

Another natural order of note in this respect is the *Lobeliaceæ*, since the tropical American species of *Siphocampylus*, found in Columbia and Ecuador, have been said to yield caoutchouc of commercial value.

Distribution of important Caoutchouc Plants.

The geogrophical distribution of the more important caoutchouc-yielding plants is imperfectly known, but a general idea of the plant areas where certain species thrive can be given. Rubber-producing plants occur in both hemispheres, and are confined to approximately 25 degs. or 28 degs. north and south of the Equator. In this area the three most important regions are, following the floral regions of the world as divided by Drude: (1) the tropical American; (2) the tropical African, including Madagascar; and (3) the Indo-Malayan region. These three regions supply nearly the whole of the rubber of commerce.

Indigenous and Introduced Plants.—It may also be said that, of the three areas enumerated, the tropical American and African are, at present, only concerned with the extraction of latex from, and cultivation of, plants which are indigenous to those areas—*Hevea, Manihot, Funtumia, Landolphia*, &c.—whereas the Indo-Malayan region, though it possesses a few indigenous species of value, such as *Ficus elastica, Cryptostegia grandiflora* and others, is directing its attention, almost exclusively to-day, to the cultivation of species introduced from the tropical American region, and to a few from the African zone. The tropical American region has been the home of the plants which have led to the rubber industry in Ceylon, Straits Settlements, Federated Malay States, and Southern India, and has supplied even tropical Africa with species which rank as of first importance at the present time.

Trees, Shrubs, and Climbers.—Another interesting feature of the laticiferous flora of these three vast regions, is the nature of the plants predominating in each area. It may be said that the caoutchouc plants of the tropical American area, are mainly of an arborescent type, *e.g.*, *Hevea brasiliensis, Castilloa elastica, Manihot Glaziovii*, and *Sapium*; a few shrubby plants, such as *Parthenium argentatum*, and climbers such as *Forsteronia floribunda*, do of course exist there.

On the other hand, the rubber industry of the African region, especially if we include Madagascar, is principally concerned with climbers or lianes—*Landolphia, Clitandra, Carpodinus, Cryptostegia*, &c.; indigenous tree forms, such as *Funtumia elastica, Ficus Vogelii*, and introduced tree forms also abound in certain areas of Africa. In the Indo-Malayan region, on the other hand, there is a very mixed indigenous type, composed of huge tree forms such as *Ficus elastica* and *Sapium insigne*, and climbers, such as species of *Willughbeia, Cryptostegia, Urceola, Leuconotis, Parameria*, &c.

The introduced plants cultivated in the Indo-Malayan region are nearly all of the arborescent type—as *Hevea, Manihot, Castilloa, Sapium, Funtumia*, &c., with a few lianes, the most prominent of which is *Landolphia*. The Table given below will show the introduced and native plants now largely exploited for rubber in the three areas:—

Important Caoutchouc Plants.
(Generic Names.)

Tropical America (including the West Indies):—
- Native. — Hevea, Castilloa, Manihot, Sapium, Hancornia, Micrandra, Parthenium, Hymenoxys, Brosimum, Forsteronia.
- Introduced. — Funtumia, Landolphia, Castilloa, Hevea, Manihot.

Tropical Africa:—
- Native. — Landolphia, Funtumia, Ficus, Carpodinus, Clitandra, Cryptostegia.
- Introduced.—Hevea, Manihot, Castilloa, Cryptostegia, Ficus.

Indo-Malay:—
- Native.—Ficus, Willughbeia, Urceola, Parameria, Cryptostegia, Chonemorpha, Ecdysanthera, Leuconotis, Rhynchodia.
- Introduced. — Hevea, Manihot, Castilloa, Landolphia.

Rubber Species.

Most companies who have gone in largely for rubber cultivation have selected trees for planting purposes, which have become known in virtue of their caoutchouc-yielding capacities. There is, however, an extraordinary degree of laxity displayed by a few individuals who simply apply for, or say they have planted, *Hevea, Castilloa, Manihot, Ficus*, &c. It is as well to state that in each of these genera, as in many others, there are numerous species known to yield caoutchouc,

but in very variable quantities and of different qualities. Undoubtedly, in tropical America and Africa the latices of numerous species frequently contribute to the rubber exported in a form known under one name, and the real rubber values of many species of *Hevea*, *Sapium*, *Landolphia*, and *Manihot*, are but little known, except to the natives on the spot. There are some companies operating in tropical America who find it to their interest to cultivate a species of *Manihot*, other than *M. Glaziovii*, Muell. Arg., though the latter is the species which has been distributed to the East, and which everyone has hitherto associated with Ceara rubber for many years. During a very brief study at Kew, the importance of correctly identifying the caoutchouc species in wild areas for subsequent developments has strongly impressed me.

We will consider a few of the more important genera previously mentioned.

Hevea.—The genus *Hevea* furnishes the largest quantity, and perhaps the best quality, of rubber in the world. It is represented by *Hevea brasiliensis*, Muell. Arg., and *H. similis*, Hemsl., in Brazil, Eastern Peru, and Bolivia; by *H. spruceana*, Muell. Arg., *H. minor*, Hemsl., *H. benthamiana*, Muell. Arg., *H. rigidifolia*, Muell. Arg., and *H. discolor* in North Brazil; by *H. pauciflora*, Muell. Arg., in North Brazil and British Guiana; by *H. lutea*, Muell. Arg., in North Brazil and East Peru; by *H. confusa* in British Guiana, and by *H. guianensis*, Aub.* In the basin of the Amazon and in the south of Venezuela and the Guianas, species of *Hevea* are abundant and scattered among other forest types; further north they are replaced by *Castilloa* and *Parthenium*, and on the Atlantic side by *Manihot* and *Hancornia*. The map which I am able to show to-night by favour of John Bartholomew and Co., will indicate the distribution of the rubber-producing areas in the basin of the Amazon.

Among the species of *Hevea* enumerated above there are several which yield large quantities of latex, but *Hevea brasiliensis* is probably responsible for the greater part of the Para rubber of commerce. *H. benthiamiana*† has been confused with *H. brasiliensis*, and is said to be cultivated, at the present time, in some parts of Venezuela.

Sapium.—The genus *Sapium*‡ has been variously dealt with, and much confusion exists to-day regarding the botanical identity of the species which are of value as sources of caoutchouc. *Sapium mexicanum*, Hemsl., and *S. laterifolium*, Hemsl., native to Mexico, may be classed as doubtful sources of caoutchouc, though the juice of the latter hardens into a kind of india-rubber. In British Guiana, *S. Jenmani*, Hemsl., is known locally as Toukpong; *S. paucinervium*, Hemsl., is said to yield abundance of latex of a kind; and *S. aucuparium*, Jacq., is considered to be of doubtful value. In South America many other species occur, but do not appear to be of much commercial value. The species known as *S. verum*, Hemsl., which occurs in Columbia and Western Ecuador has, according to Hemsley, been confused with *S. biglandulosum*, once regarded as a polymorphic form, and the so-called source of "Columbia Virgen"; that occurring in Western Ecuador has been described by Dr. Preuss as being a good rubber tree. In North Brazil, *S. ciliatum*, Hemsl., is said to form a small tree from 12 to 15 feet high and to yield india-rubber. Another species † occurring in Venezuela, Columbia, and Ecuador and known as *S. stylare*, Muell. Arg., is said to yield its greatest quantities of rubber at an elevation of 5,000 feet, where the mean temperature is between 57 and 61° F. In Columbia and Ecuador the *Sapium* species are intermingled with those of *Castilloa*, and are considered to be the source of the white rubber "Caucho blanco;" in other parts of South America the trees are intermingled with *Hevea* species, the latex of both being mixed together in the preparation of certain grades of rubber.

Castilloa.—*Castilloa* is a genus represented by certain valuable species in tropical America. As in the case of *Sapium* the synonymy is a trifle confused, and will become more so if the representations of Cook and Seffer † are seriously considered. There are three species recognised at the present time, and other names have been given to forms which probably present certain minor differences when compared with the true *Castilloa elastica*, Cerv. *Castilloa elastica*, Cerv., *C. Tunu*, Hemsl., and *C. australis*, Hemsl., are the three recognised species in tropical America. *C. Tunu* was once confused, at Kew, with *C. elastica*; the name *C. markhamiana* has been applied to two plants, one of which (*C.*

* "Icon. Plantarum," xxv., Series 4, 6, 1899.

† "Icon. Plantarum," xxvi., Series 4, 6, 1899.

‡ "Icon. Plant." Hooker, xxvii., Ser. 4, 7, 1901.

* "Icon. Plantarum," Series 4, 8, 1905.

† Rubber planting in Mexico and Central America, Agr. Bull. of Straits and F.M.S., Jan., 1907.

markhamiana, Markham), turned out to be the ordinary *C. elastica*, Cerv., and the other (*C. markhamiana*, Col.) to be *Perebea markhamiana*, Hemsl. Cook and Seffer have suggested and used the name *C. lactiflua* for one form; others speak of varieties, rubra, alba, nigra, nicaraguensis, and so forth.

It should be clearly pointed out that *C. elastica*, Cerv., occurs in Mexico, Honduras, Guatemala, Salvador, Nicaragua, Costa Rica, Columbia, and Ecuador; in this range of latitude of about 37° it may be expected to show some variation according to habitat. *Castilloa elastica* is probably distributed over a wider range of latitude than any other rubber-producing plant, occurring, as it does, from Mexico to parts of Southern Brazil. It has been known to science longer than most other caoutchouc plants, having been first described by Cervantes* at a meeting of the Royal Botanic Garden of Mexico in July, 1794. In many parts of Mexico and Central America it is the only rubber plant exploited, but in other areas is the predominant type, and occurs mixed with species of *Sapium*. Its presence has not been confirmed in the Guianas and Venezuela.† It yields an excellent rubber. *Castilloa Tunu* occurs frequently in the forests of British Honduras and Costa Rica. It has been described as yielding rubber in abundance and of good quality. *Castilloa australis* has a limited distribution, and, though it often occurs in the Peruvian forests, has not been described as a good species for caoutchouc. Hemsley states‡ that it possesses a clammy, milky juice.

Manihot.—The genus *Manihot* contains one species—*Manihot Glaziovii*, Muell. Arg.—which yields Ceara or Maniçoba rubber. It occurs wild in the forests of Brazil,|| and its produce is shipped from the ports of Ceara, Bahia, and Pernambuco. It has been distributed to Africa, Mauritius, Madras, Burma, Ceylon, Straits Settlements, Seychelles, Zanzibar, Jamaica, Dominica, &c.

The wild trees of this species are not distributed over as large an area as are those of *Hevea*. The Brazilian forests containing large numbers of *Manihot* trees are mainly between 3 to 10 degrees from the equator, the eastern corner of Brazil, including the States of Ceara, Pernambuco, Piauhy, Maranhao, and Rio Grande do Norte, being of especial interest. Trees of *Manihot Glaziovii* occur at Para, and to the north-west this species is replaced by those of *Hevea*. In some parts of Brazil two plants are confused with this species; one is known as "Maniçoba"—the true form—and another, "La fraca," which is probably a variety of the same species, is described as being capable of yielding good caoutchouc.

There appears to be a species of *Manihot* differing widely from *M. Glaziovii*, which is now being cultivated in parts of tropical America; perhaps our Chairman can give us some information regarding an interesting species of *Manihot*, seedlings of which, I understand, are being reared at Kew.

Parthenium, or Guayule Rubber.—The name "Guayule" is given to the rubber obtained from *Parthenium argentatum*, A. Gray. This plant is a *Compositæ*; it is small varying from 8 to 40 inches in height, and has a much branched stem. According to Endlich, it occurs over a large portion of the bush prairies in Northern Mexico, and also extends into the United States; it is met with in Texas, New Mexico, and Arizona. Its occurrence has been reported but not confirmed in Southern Mexico, Central America, and Venezuela. It has been stated that the area in Northern Mexico, over which this plant is distributed, is about 29,000 square miles; it occurs from 3,000 to 5,600 feet above sea-level as well as upon the plateaux.

Hancornia.—*Hancornia speciosa*, Muell. Arg., is the name of the tree which yields the Mangabeira or Mangaba rubber of Brazil. It is widely distributed throughout Brazil, but is not regarded as being of exceptional value in Pernambuco, Bahia, Matto Grosso, or Sao Paulo. It has been reported in Bolivia and Eastern Peru. The tree attains a height of 13, 16, and 23 feet, is well supplied with branches, and grows well in dry districts at an elevation of 500 to 600 feet above sea-level.

Forsteronia.—This genus possesses two species, both lianes and natives of tropical America, which furnish useful rubber; they are found in Jamaica, and between Mexico and the South of Brazil. *Forsteronia gracilis*, Muell. Arg., occurs abundantly in British Guiana, where it is known, according to Jenman, by the name of "Macwarrieballi," and is said to yield rubber of good quality. *Forsteronia floribunda*, DC., appears to be found only in Jamaica, where it is known locally as

* "The World's Commercial Products," Parts 9 and 10, 1906.

† Jumelle, "Les Plantes a Caoutchouc et a Gutta," 1903.

‡ "Icon. Plantarum," xxvii., Series 4, 7, 1901.

|| Martius' Flora Brasiliensis, XI., Part II., p. 443.

the milk-wythe or milk-vine. It occurs as a climbing shrub in the forests in the interior of Jamaica, and yields a caoutchouc of value.

Hymenoxys or Colorado Rubber.—A species of *Hymenoxys** Cass., has been reported to occur "abundantly in the hills and mesas in the vicinity of Salida, the belt extending into the San Luis Valley, Gunniston County, and as far south as New Mexico." This plant is the source of what has been termed "Colorado" rubber, the roots often yielding as much as 10 per cent. of rubber of a somewhat inferior quality.

Micrandra, Brosimum, &c.—Before concluding the chief American rubber-yielding species, reference may be made to Micrandra, Brosimum, and Siphocampylus. The genus, Micrandra, is placed in the *Euphorbiaceæ*; two species are known which occur wild in Central Brazil, and are said to form part of the Amazon rubber. *Brosimum galachodendron*, the cow tree or "Palo de Vaca," is a large tree which occurs in South America and yields a resinous rubber. *Siphocampylus caoutchouc*, Don, occurs wild in Columbia, *S. Jameaonianus*, DC., in Ecuador, and *S. giganteus*, Don, in tropical America; all three are said to yield rubber of value.

African Rubber Plants.

Numerous plants are known in tropical Africa and Madagascar, but among the more notable genera we need only include, for our present purposes, *Landolphia*, *Clitandra*, *Carpodinus*, *Funtumia*, *Mascarenhasia*, *Pleiocarpa*, *Rauwolfia*, *Ficus*, and *Cryptostegia*.

Landolphia.—The genus *Landolphia* has supplied a great part of the rubber from Africa, and large numbers of these climbing plants have been destroyed by native collectors of rubber. There are about forty species known in this genus many of which supply large quantities of good caoutchouc; other species yield resinous latices and many yield abundance of rubber from their roots. Several species have been previously known under the genus *Clitandra*, and some confusion exists with regard to the nature of their latices as well as their botanical identity. Among the species said to yield good rubber are *L. Heudelottii*, A.DC., *L. Kirkii*, Dyer, *L. Dawei*, Stapf, *L. owariensis*, Beauv.; several species have been reported as yielding rubber of uncertain value or in doubtful quantities among which may be mentioned *L. kilimandjarica*, Stapf, *L. Buchananii*, Stapf, *L. Stolzii*, Busse, *L. droogmansiana*, De Wild., *L. Klainei*, Pierre, *L. reticulata*, Hallier, *L. petersiana*, Dyer, *L. Pierrei*, Hua, *L. lucida*, var. hispida, Hall. One of the most notable species said to yield root rubber is *L. Thollonii*, Demierve; it occurs abundantly in the French and Lower Congo and Angola. Much money and time have been wasted in connection with certain species; those which may be described as worthless for rubber purposes include *L. florida*, Benth., abundantly distributed in parts of Sierra Leone, Gold Coast, Lagos, British East Africa, &c., and also *L. ugandensis* Stapf, and *L. subturbinata*, Stapf. These plants, though they are not the most suitable for cultivation, are of much importance at the present time.

* Kew Bulletin, l.c.

Clitandra and Cryptostegia. — These genera furnish a small quantity of root and stem rubber. The important species of *Clitandra* appear to be abundant in the Congo, Liberia, Uganda, &c. *C. henriquesiana*, K. Schum., is an erect shrub said to yield root rubber; *C. orientalis*, K. Schum., which occurs frequently in the Congo Free State, and has recently been found by Dawe, at an elevation of 4,000 feet in Uganda, is a vine furnishing an excellent rubber; *C. Nzunde*, De Wild., *C. flavidiflora*, Hallier, *C. nitida*, Stapf, and *C. cirrhosa*, Radlk., are also described by some authorities as yielding rubber in Africa.

The genus *Cryptostegia*, to which we shall refer in another section, also furnishes species of value as rubber-yielding plants.

Carpodinus.—The value of most of the African species of this genus has often been discussed; many contradictory statements have been made regarding the value of the root-rubber from *C. lanceolatus*, K. Schum.; and *C. hirsuta*, Hua ex chev., *C. uniflora*, Stapf, *C. dulcis*, Sab., *Barteri*, Stapf, *C. acida*, Sabine, *C. oocarpa*, Stapf, *C. leucantha*, K. Schum., have been variously described as yielding rubber of good, variable, and questionable value.

African Rubber Trees.

Among the indigenous tree forms which are of value to rubber collectors those belonging to the genera *Mascarenhasia*, *Funtumia*, and *Ficus* are of the most importance.

The genus *Mascarenhasia* is said to possess several species of value, but it is doubtful whether their produce is of much importance

in the rubber export from Africa. *M. lisianthiflora*, DC., yields latex from which rubber possessing 88 to 91 per cent. of caoutchouc has been obtained; *M. anceps*, Boiv., and *M. longifolia*, Jum., are also said to yield good caoutchouc, whereas the products from *F. elastica*, Schum., and *M. utilis*, Bak., are described as being of doubtful value.

The genus *Ficus* possesses several species which are exploited by African rubber collectors: among those of note, may be mentioned, *F. Vogelii*, Miq., *F. whytei*, Stapf, *F. guineensis*, Stapf, and *F. johnstonii*, Stapf.

Funtumia.—This genus has lately become well known as a source of rubber in Africa. It is still much confused with the genus *Kicksia*, and it is as well to again point out that Africa does not possess a single species of *Kicksia* of value as a rubber-producing plant. The four species of *Kicksia* acknowledged by Stapf, are found only in Java, Celebes, Philippine Islands, and Borneo The genus, *Funtumia*, is partly African, and is represented by three species—*F. elastica*, Stapf, *F. africana*, Stapf, and *F. latifolia*, Stapf.

The species of importance as a source of rubber in Africa is *F. elastica*, Stapf; its occurrence has been recorded in Liberia, Gold Coast, Ashanti, Lower Nigeria, Cameroons, Mundame, French Congo, Congo Free State, Uganda, &c. The rubber from this species is very valuable, possessing, when properly prepared, from 80 to 90 per cent. of caoutchouc. *F. elastica* has been described as a tree with a cylindrical trunk which attains a height of 100 feet; sometimes the trees are very abundant in local areas; and out of an area of about 54 square miles as many as 1,760,000 trees have been estimated to occur.

EASTERN RUBBER PLANTS.

A few remarks can now be made regarding some indigenous species in the Indo-Malayan region. The most noteworthy genera are *Ficus*, *Cryptostegia*, *Leuconotis*, *Parameria*, *Urceola*, *Willughbeia*, *Chonemorpha*, *Ecdysanthera*, and *Rhynchodia*.

Ficus.—The tree known as *Ficus elastica* (L.) indigenous in Assam, Burma, and Malaya, furnishes a large proportion of the wild rubber exported from India. It grows to an enormous size, but cannot be tapped until it is many years old. It does not appear to have given as good yields either in the Indo-Malayan region, where it is indigenous, or in parts of West Africa, Egypt, and Ceylon, where it has been introduced. A species of *Ficus* has been exploited in British New Guinea, but as yet the reports regarding this are not very encouraging. The latices from *Ficus comosa* and *Ficus indica* sent from the Botanic Gardens, Calcutta, were examined by the Imperial Institute, London, but as they contained about 80 per cent. of resinous matter were reported upon as being almost worthless.

Cryptostegia.—The genus *Cryptostegia* furnishes two species of value as sources of rubber: *C. grandiflora*, Bra., and *C. madagascariensis*, Boj.; these are both lianes, and the former occurs in India. Many consider that *C. grandiflora*, is an Indian species naturalised in Madagascar, whilst others consider it to have been introduced into India from Madagascar. It is cultivated in a few gardens in India; the rubber is of fair quality, possessing about 80 per cent. of caoutchouc, though the harvesting, as at present carried out, is rather costly.

Leuconotis.—Plants of *Leuconotis eugenifolia*, DC., occurring in Penang, Sumatra, and Borneo, and *L. anceps*, Jack., of Borneo, yield very poor rubber; *L. elastica*, Becc., of Borneo, is, according to Beccari, a plant which yiel?s an excellent rubber, and the latex of *L. subavenis*, Boerl., also common in Borneo, is said to be used for adulterating purposes.

Parameria.—The liane, known as *Parameria glandulifera*, Benth., found more or less frequently in the Malay Peninsula, Burma, Andamans, Borneo, Philippines, &c., is said to yield a fair caoutchouc; the dry material may possess over 90 per cent. of caoutchouc. The latex of *Parameria pedunculosa*, Benth., has been reported upon by the Imperial Institute, but as the dry material possesses 88 per cent. of resin and only about 10 per cent. of caoutchouc, it cannot be said to be of much value.

Urceola.—Several species of this genus have been reported as yielding fair quantities of useful rubber. *Urceola esculenta*, Benth., common in British Burma and other parts of India, may yield dry rubber possessing 75 to 80 per cent. of caoutchouc. *M. elastica*, Roxb., found in Malaya; *U. acute-acuminata*, Boerl., occurring in Borneo; and *U. Maingayi*, Hook, f., found in Singapore and Borneo; these are described as yielding latices sometimes rich in caoutchouc. There is one species—*U. brachysepala*, Hook, f., which occurs in Malaya, Borneo, and Java, and is, according to Jumelle,

capable of being cultivated up to an altitude of 700 metres, and from which 25 grammes of caoutchouc have been obtained per plant.

Willughbeia, &c.—The plants of the genus *Willughbeia* grow into huge climbers analagous to the *Landolphias* of Africa; two species have been reported upon for their caoutchouc-yielding properties. *W. firma*, Blume, occurs, according to Stapf, in Sumatra and Borneo. It grows sometimes to a length of 40 metres, but the rubber from this species as it arrives in Europe loses sometimes as much as 4 per cent. in washing. The latex of *W. edulis*, Roxb., a species common in some parts of Assam and Malacca, yields a very resinous rubber possessing only about 10 per cent. of elastic caoutchouc-like substance.

The reports of the Director of the Imperial Institute on the rubber yielded by *Chonemorpha macrophylla*, and *Rhynchodia Wallichii* from Burma, and the latex of *Ecdysanthera micrantha* from Rangoon, show that in these plants there is much of interest to rubber cultivators.

It is obvious from the foregoing that there are very many species of rubber-yielding plants scattered throughout the tropical world. We may now proceed to study the wild and plantation species, and the nature of the channels in the tissue of these plants wherein rubber accumulates.

Wild Rubber.

Hitherto wild rubber has been obtained from forest trees or vines indigenous in local areas, and has been collected mainly by native labourers who have bargained their harvests for articles of food, &c., and who in their work have adopted methods requiring the minimum skill and involving the destruction of the plants. To-day the business of rubber exploiting in tropical America and Africa is being supervised by companies who are aiming at the preservation of the original wild plant, and in some cases the re-afforestation of areas poorly represented in wild rubber species, by indigenous or introduced rubber-yielding trees of known value. The terms under which much land has been leased provide that a definite acreage shall be planted each year, thus ensuring that the sources of supply shall be maintained.

Importance of Wild Rubber Supplies.—The sources of wild rubber are receiving much more consideration and care than was the case a few years ago, and may for many years to come be expected to supply annually the equivalent of approximately 1,000,000 acres of plantation rubber; should the supply from wild sources become scarce—an improbable occurrence—it would be impossible for the plantations to supply the balance for many years to come, as the producing capacity of the land now alienated for rubber in the East will only be, in 1912 or 1913, some 12,500 to 25,000 tons per year. The rubber manufacturers have hitherto been dependent, almost entirely, on wild rubber; and it seems illogical to suggest that the rubber forests on which so much new capital and enterprise have been recently expended, and in which prominent scientific and business men are concerned, will be unable to satisfy the increased demand expected in the next few years; it may confidently be regarded as the principal source of rubber for the next half-score of years, for the simple reason that plantations in the proper sense do not exist to produce what will be required.

Developments in Wild Rubber Areas.—Though the extraction of rubber from indigenous trees, vines, and shrubs in African and American forests has been hitherto mainly carried out at the sacrifice of the plants yielding caoutchouc it must not be surmised that this policy is always continued. Most of the companies of recent birth, formed for the exploitation of rubber from wild sources, are paying attention to the planting of areas which possess a fair proportion of rubber trees.

Many English companies operating in America and Africa are developing their properties in this manner, but for present purposes I cannot do better than give you an idea of what is happening in the Congo State, according to information obtained authoritatively and placed at my disposal by Mr. Johnston, of Little and Johnston, London. The information was obtained, I understand, from M. Arnold, Minister of Agriculture, Brussels, who has kindly sent numerous rubber samples, now submitted for your inspection. You will notice that rubber samples, labelled as follows, are included:—*Funtumia elastica*, *Landolphia klainei*, *L. Gentilii*, *L. owariensis*, *L. Thollonii*, *Clitandra Arnoldiana*, *Ficus elastica*, *F. negbudu*, *Manihot Glaziovii*, *Hevea brasiliensis*, as well as material from Lake Leopold II., Uelle, Aruwimi, Equator, Mongala, Lopori, and Kassai, in the Congo. Most of the material represents what can be obtained from plants indigenous to the Congo, but *Ficus elastica*

is native to India and Malaya, and *Hevea* and *Manihot* to tropical America. The following are some interesting extracts from the translation :—

"The State Laws, since the year 1899, have prescribed that there shall be planted annually a number of trees or creepers which shall not be less than 150 for every ton of rubber collected during the same period. In 1902, the number of rubber trees or creepers to be planted annually under the conditions fixed by law was increased from 150 to 500. In 1904 a new decree was made stipulating that whoever collected rubber in the forests or State lands, is bound to plant annually at least fifty young rubber trees or creepers, and fifteen root rubber plants per 100 kilograms or fraction of 100 kilograms of fresh rubber collected during the same period.

"On the 1st of January, 1906, the rubber plantations, established by the State, included nearly 9,500,000 plants, of which 8,575,000 creepers, 750,000 *Funtumia elastica* and 157,000 different trees, including *Hevea brasiliensis*, *Manihot Glaziovii*, *Ficus elastica*, *Castilloa elastica*, and *Castilloa Tunu*.

"To avoid losses resulting from the bad choice of land, the Government has authorised that supervision of the rubber plantations shall be made in each district, either in execution of the legal provisions or in conformity with Government instructions, at one or several places recognised as being favourable to rubber cultivation by the State agriculturists, the latter being charged with the supervision of plantation on behalf of the State.

"In 1906 the State sent more than 20,000 seeds of *Hevea brasiliensis* to the Congo . . . . orders for seeds for 1907 have already been given; at least 100,000 seeds will be sent.

"The State has decided to give extension to the cultivation of *Hevea brasiliensis* in the Congo.

"The State has procured 15 different instruments for tapping, reviving, and strengthening the rubber plants."

The same might be said of developments in almost every other part of tropical Africa and America, but the above will serve to show that there is likely to develop a pseudo-wild source of rubber in the future.

In some parts of Africa the trees of *Funtumia elastica* are said sometimes to occur in clusters and in such areas to be very abundant. In parts of Mexico and Brazil investigated by many botanists, *Castilloa*, *Hevea*, *Sapium*, and other species are said to occur frequently. But it must not be concluded that in such areas there are always large numbers of mature and tappable trees; in many parts of Mexico I have been assured, by a prominent resident there, that it is rare that one finds more than one or two trees of *Castilloa elastica* to an acre of land; what trees did exist in days gone by have been largely destroyed or rendered almost valueless by ruthless native tapping, and one can but conclude that in many instances the profits from the few wild scattered trees will be largely swallowed by the expenditure involved in the employment of skilled men in searching for them; of course, they are worth having, but their fewness makes one wonder whether the wholesale clearing of forest prior to planting as adopted in the East, where wild rubber trees do not exist, is after all a serious disadvantage.

Change in Wild Rubber Areas.—The material exported from the wild rubber areas in America will probably retain much of its present character, whereas that from tropical Africa may show considerable changes in the future and tend to become somewhat similar to that from America. This is suggested from a study of the developments which are now going on in both countries; in American areas attention is mainly directed to the cultivation and exploitation of species indigenous there, and though a few species of *Landolphia*, *Funtumia*, and *Ficus* from Africa and the Indo-Malayan region have been tried, they do not appear to give very satisfactory results. On the other hand, nearly every part of tropical Africa is carrying out extensive experiments with *Hevea*, *Manihot*, and *Castilloa* species from America, and in consequence of the success which has already been achieved one of the three American genera is likely to be largely adopted. The cultivation of climbing plants and of root rubbers is generally more difficult and expensive than that of arborescent forms, and it appears probable that the produce of the latter will largely increase and that of the former decrease in quantity. Judging from results obtained it appears to me, though I may be quite wrong, that the cultivation of species of *Hevea*, *Castilloa*, *Funtumia*, *Manihot*, *Sapium*, and arborescent forms similar to them, will predominate in the future, and that of species of *Landolphia*, *Cryptostegia*, *Clitandra*, *Carpodinus*, and *Willughbeia* gradually become relatively insignificant; plants of the former group require less supervision, they attain maturity at an earlier age, they allow of continuous tapping operations for years on the same tree, and under certain conditions yield rubber in larger quantity than do those of the latter class.

In the Indo-Malayan region, the indigenous species of *Cryptostegia*, *Leuconotis*, *Para-*

meria, *Rhynchodia*, &c., and even of *Ficus* and *Sapium*, are gradually being neglected in preference to those from tropical America. There the species of *Manihot*, *Ficus*, and *Castilloa* do not appear to give as favourable results as *Hevea brasiliensis*, and before very long that area will stand out remarkably for the uniformity of the greater part of its exported rubber. *Hevea brasiliensis* appears to have been taken up in the East, almost to the exclusion of all other rubber-yielding plants, and even the coconut palm has been felled in order to make room for this favourite species. It is very rare, in Ceylon, that one meets with plantations of *Castilloa*, such as are described to exist in Mexico, or of *Manihot* as in parts of Brazil.

Differences Between Wild and Plantation Areas.

Eastern rubber estates are nearly all planted; only a few possess indigenous trees or climbers, and the waiting period is consequently very long; properties in Malaya, possessing trees of the indigenous *Ficus elastica*, have usually all been regularly and systematically planted with seedlings reared in the nursery, and in this feature differ from the wild or pseudo-wild areas.

Again it may be stated, with some amount of accuracy, that the rubber output from most parts of tropical America and Africa is dependent upon native efforts; there the amount of skilled supervision is small compared with that on planted estates generally. I have been informed by residents in prominent wild-rubber areas that they have only a few practical men of repute. We know that in Ceylon, Southern India, Federated Malay States, Straits, &c., the estates are managed by Europeans of considerable tropical experience, and that their systems of keeping records and accounts, and their knowledge of engineering, languages, &c.—all of which play a very important part in the ultimate success of any rubber plantation—are such as to command complete confidence. The number of planters drawn from Ceylon to engage in the rubber industries of the Malay Archipelago is very large, and from a few years' experience in that island one can anticipate that good work will be done.

It is now generally admitted that *Hevea brasiliensis* has, on Eastern plantations, been proved to give excellent results, and to stand tapping operations even of a very drastic nature; this cannot yet be asserted for many *Castilloa* plantations in Mexico and Central America, or even for those of Ceara in Brazil, or *Landolphias* and *Funtumias* in Africa, though we naturally expect favourable results from many of these.

The plantations of rubber trees are, as most of you are aware, capable of being worked more economically than forests of mixed plants; the number of rubber trees is generally accurately recorded, they are capable of being minutely inspected daily, and there are often more rubber trees in one acre of an Eastern plantation than in several square miles of American or African forest. Of course, it is possible to plant up areas possessing indigenous rubber-yielding plants, but the abundance and cheapness of the Indian, Javanese, and Malay labour make it possible to do planting work cheaper in the East than in most parts of the tropics.

It is asserted by many that tropical plants will thrive best in their native habitats; this statement can be seriously contested, and is often contradicted by the results obtained from introduced plants in the tropics. True, the indigenous rubber-producing plants in the American and African forests represent types which, in their native countries, have survived in the struggle for existence, and have often successfully contested certain pests. But it is well known that a change of climate is often beneficial to the plants, and certainly the results obtained with introduced species in the East justify one in anticipating that the rubber plantation industry will give satisfaction to most persons interested in it.

Distribution of Rubber Plants and the Eastern Industry.

At the present time it may be stated that many trials of Brazilian species have been made in Africa, East and West Indies, India, Malaya, Borneo, Philippines, New Guinea, Fiji, &c., and of African species in parts of America and the East and West Indies. In the distribution of rubber-yielding plants to various parts of the British Empire Government have taken considerable interest.

The gradual development of the plantation rubber industry to the position it occupies today can be associated largely with the activity of the various Government Botanic Departments in different parts of the world. The Royal Gardens, Kew, naturally ranks of first importance in this respect, as a centre of distribution of species collected from all parts of the tropics. According to the Kew Bulletin

(No. 3, 1907), *Hevea brasiliensis* was first sent from Kew to India in 1873; in 1876 to Burma, Ceylon, Java, Singapore, West Indies; in 1877 to Mauritius and West Africa; and in 1878 to Fiji. Plants of *Hevea spruceana* were first despatched to Ceylon in 1883; to India, Java, Singapore, West Africa, and West Indies in 1887; and to Fiji in 1893. *Castilloa elastica* was first sent to India in 1875; to Ceylon, Java, and West Indies in 1876; to Singapore, Mauritius, and West Africa in 1877; and to Fiji in 1882. *Manihot Glaziovii* was first sent to India, Ceylon, Singapore, and West Africa in 1877; and to Java, Fiji and the West Indies in 1878. *Landolphia* plants were first despatched to Ceylon and the West Indies in 1880; to Singapore and Fiji in 1881; and to Mauritius in 1883; and to Java in 1888. *Funtumia elastica* was sent from Kew to India, Ceylon, Java, Singapore, and the West Indies in 1896, and a second consignment was forwarded to the same countries in 1897.

Ceylon.—The Ceylon Para rubber industry has been developed from the offspring of the plants originally obtained by, and for, the Indian Government in 1876 and 1877. These plants were sent to Ceylon, in whose Botanic Gardens they were carefully reared, and supplies distributed to many parts of the world.

As explained above, plants of *Castilloa elastica*, *Manihot Glaziovii*, and species of *Landolphia*, *Sapium*, *Palaquium*, &c., have also been received in Ceylon, from Kew and other Botanic Gardens direct. Rubber plants have been sent from Ceylon to the Straits, Borneo, Java, Philippines, Seychelles, Queensland, New Guinea, Africa, West Indies, and even Brazil.

Singapore.—The Botanic Gardens at Singapore have also received many rubber-yielding species from Ceylon, and other countries. Mr. H. N. Ridley has kindly supplied me with the following information:—Twenty-two plants of *Hevea brasiliensis* were received on June 11th, 1877, from Kew, and a further consignment was despatched from Kew in the following year; already very large and successful acreages have been planted from the offspring of these parents. In 1876, plants of *Castilloa elastica* and *Manihot Glaziovii* were received from Kew; the former were failures, and the latter are not looked upon with favour in the Straits. In 1898, plants of *Funtumia elastica* and *Mascarenhasia elastica* were received from Kew, but they appear to grow very slowly. Plants of the vines—*Landolphia Watsoniana*, *L. petersiana*, and *L. Kirkii* were received in 1881 from Kew, but none have been successful as cultivated plants, though nearly all grow well. In the same year a species of *Hancornia*, which subsequently failed, was also received from Kew. *Ficus elastica*, at present largely cultivated in the Straits and Federated Malay States, was received at Singapore before 1875. It is a native of Perak, and caoutchouc from the wild trees of this species was obtained before 1876.

India.—My information regarding the introduction of rubber-producing species to India has been obtained from Mr. I. H. Burkill, Officiating Reporter on Economic Products, Indian Museum, Calcutta. For many years thousands of seeds of *Hevea brasiliensis* have been annually sent from the Henaratgoda Botanic Garden, Ceylon, to the Government of India, and in addition to these, officials and planters have frequently secured seed supplies of other species from Ceylon and the Federated Malay States. I append a

INTRODUCTION OF RUBBER PLANTS TO INDIA.

Species.	When Received.	Whence.	No. of Plants.	Results Obtained.
Hevea brasiliensis	1873	Kew	6	Not favourable.
,, ,, ...	1876	,, ...	50	Reached in bad condition.
,, ,, ...	1877	,, ...	50	Did well.
,, ,, ...	1879	Ceylon	178	Fully established.
Castilloa elastica......	1881-1882	,, ...	2	Not passed experiment stage.
Manihot Glaziovii	1877	Kew (50)	50	Not passed out of experiment stage.
Funtumia elastica	1899	West Africa seeds yielding	1,000	
,, ,, ...	1903	Trinidad, 1,000	—	Not passed experiment stage.
,, ,, ...	1904	Trinidad, 8,000 seeds	—	
Other species—				
Landolphia Kirkii	1878-1879	Zanzibar seeds	—	Failed.

synoptical statement, showing the date of introduction of the more important foreign species, at present in India, supplied by Mr. Burkill.

Plantation Rubber.

These considerations bring us to the subject of the plantation rubber industry as at present developed in the three great rubber areas. Its exact importance in areas where indigenous species are exploited is difficult to ascertain, and the various compilations regarding this point show considerable differences in areas planted. Dr. Olsson-Seffer states that *Castilloa* is being planted over large acreages in Central America and Mexico, and according to him this work is proceeding in Guatemala, Nicaragua, Panama, Costa Rica, Honduras, and San Salvador; in the Central American Republics there are reported to be about 12,230 acres under rubber, mainly *Castilloa elastica*. In Mexico, according to Seffer, on December 1st, 1906, there were about 82,620 acres planted and a prospect of planting 10,000 acres more in 1907. Seffer states that "this area under cultivation represents at least £6,000,000 that are nominally invested in rubber plantations." In Ecuador, property owners have begun to plant trees of *Castilloa elastica*, and plantations now exist "especially round the Balzar and Fenguel districts and in some parts of the provinces of Manabi and Esmeraldas." The latest official report states that there are about one million trees now planted in Ecuador, and that over 95 per cent. of the present export is of wild rubber and only 5 per cent. of cultivated rubber. It is difficult to obtain any reliable information regarding the planted acreage in Brazil, the West Indies, and Africa, and beyond stating that the operations contemplated are on a very large scale, I do not propose, at present, to commit myself.

Indo-Malayan Plantation Rubber.

We do, however, possess some detailed knowledge regarding the plantation industry in the East; and as Ceylon, Straits Settlements, the Federated Malay States, Southern India, Borneo, &c., are now of considerable importance, in this respect, we may devote some attention to this area.

Southern India.—Mr. Windle, in his lecture at the Ceylon Rubber Exhibition in September, 1906, made the following statement:—

"In 1903 some good-sized areas were opened, and since then planting has been extending fast. I should put 1904 as the year in which, with the exceptions mentioned, Southern India really began its serious planting of rubber. As to areas open to the present time, I have done my best to collect some figures on the point, and am fairly certain that they are not under the mark:—

	Acres.
The Nilgiris and S. Wynaad..	1,200 mostly in coffee (Para chiefly)
Malabar and S. Wynaad	400 (Para, Castilloa and Ceara)
Coimbatore	1,100 (Para)
Cochin	1,000 ,,
Travancore	6,000 ,,
Shevaroy Hills	1,200 (mostly Para in coffee)
Pulneys	100
Mysore	—
Coorg	2,000 (chiefly Ceara)

Since the above statement was made several companies have commenced active operations in the Travancore district and also in Burma, and we may soon expect to see, in Southern India and Burma, about 20,000 to 30,000 acres of planted rubber.

Ceylon.—The island of Ceylon has evinced considerable activity in the planting of rubber trees, as the following figures will indicate:—

Year.	Acreage.	Year.	Acreage.
1898 ..	750	1903 ..	7,500
1899 ..	1,250	1904 ..	11,000
1900 ..	1,750	1905 ..	40,000
1901 ..	2,500	1906 ..	100,000
1902 ..	4,590	1907 ..	130,000 (estimated.)

The importance of this acreage will be manifest when it is remembered that that under tea, which has been long established in Ceylon, is only 382,000 acres, and that under cacao 34,000 acres.

Malaya.—In the Federated Malay States a total of 150,000 acres has been reported as alienated for this product. According to Carruthers, the following is the estimated average for the middle of 1906 in the Federated Malay States:—

Under one year old		25,000 acres.
One year and under two years old		15,000 ,,
Under three	,,	4,500 ,,
Under four	,,	4,000 ,,
Under five	,,	8,500 ,,

Other authorities estimate that in Malaya, Malacca, Sumatra, &c., there were at the end of 1906 about 90,000 acres planted; in Java about 40,000 acres; and in Borneo about 12,000 acres. Before very long we hope to be able to state definitely that in the Indo-

Malayan region alone there are one-quarter million acres of planted rubber trees, mainly of *Hevea brasiliensis*.

Planting of Rubber Trees.

A very responsible journal, viewing the probable future developments less than two years ago, predicted that by the end of 1906 there would be planted in the East about 100,000 acres of rubber trees, and suggested that an average yearly increase to the plantation rubber acreage in the East might be taken in round figures at 20,000 acres. But it is obvious from previous considerations that there are now nearly one-quarter of a million acres, and the propositions now being considered in London alone suggest that during the next few years the annual increase in planted acreage is likely to be on a very large scale especially in Ceylon, Malaya, Borneo, Java, and Sumatra.

Thousands of acres have been planted during the last two years, and the progress of events in Ceylon is of interest, since we have seen that that island, by its phenomenal activity, has planted more since the beginning of 1905 than it did in the whole of the previous twenty years, though seeds were then available.

The recent activity in Ceylon has placed that small island, as far as insular plantation acreage is concerned, in the first position in the British Empire, but how long it will hold that position it is difficult to foresee. Furthermore, Ceylon doubled its rubber production in 1906 over 1905, the amount produced, less that re-exported from the Straits and China, being approximately 140 tons.

Importance of Plantation Supplies.

The future importance of plantation rubber is one which cannot be neglected, especially in view of the enquiries regarding the supplanting of wild rubber by that from plantations. There can be no doubt about the question of economy in the two classes: very many of the wild-rubber areas in Africa and America are now being gradually transformed into plantations of some kind or other. The general tendency of present-day operations is to lead to an extension of regularly-planted estates where wild-rubber forests or ordinary forests previously existed and a reduction of genuine wild-rubber areas; in view of these facts it seems desirable to determine the equivalent of the wild areas now exploited in terms of plantation acreage. Assuming that the consumption for 1906 was 65,000 tons, what plantation acreage would be required to supply that amount? During 1905 and 1906 the trees on plantations in Ceylon, Federated Malay States, Straits Settlements, and parts of Southern India gave an average annual yield of 1 to 1½ lb. of dry pure rubber per tree. If you take the minimum yield of ¾ lb. per tree per year, from estates planted twenty by fifteen feet apart, the yield per acre is at the rate of one ton of pure rubber per twenty acres; if you allow at the rate of 1½ lb. per tree, which is by no means excessive where labour for tapping is available, you have one ton of rubber per year from every block of ten acres. The 65,000 tons of wild rubber supposed to have been consumed in 1906 may be roughly estimated to have contained about 20 per cent. of impurities, so that its equivalent in pure plantation rubber would be about 52,000 tons; to produce this amount you would require 1,040,000 acres on the minimum estimate, or 520,000 acres only on the estimate of 1½ lb. of pure rubber per tree. You will see from the figures given elsewhere that the plantation acreage in the Indo-Malayan region alone already promises to be not not much less than 250,000 acres.

Those calculations give you some idea of the position of the present plantation acreage in the East in relation to last year's consumption. But it may be logically stated that this is a false standpoint to argue from, since the trees on the land alienated for rubber to-day will not be in bearing for many years to come, and in that interval the consumption will at least show the normal yearly increase; these are contentions which cannot be negatived. If you assume that the world's consumption will increase at the rate of only 5,000 tons per annum, and that the output from wild sources will remain constant at about 60,000 tons per year, you may still require in 1913 no less than 640,000 acres of cultivated plantations to supply the material above that produced from wild sources. It is fairly safe to reckon that 80,000 additional plantation acres will be required every year to supply the annual incremental increase in consumption of 5,000 tons of wild rubber. It is believed that more than that amount will be planted yearly, and, therefore, that plantation rubber will sooner or later obtain a prominent, if not the commanding, position as a source of future rubber.

Plantation and Wild Rubber Supplies.

In the past, wild rubber has controlled the market of the world, and must continue to

be of ruling importance during the next few years. There are a few people who believe that it will always occupy a dominant position, and that plantation rubber can never do more than supply a small fraction of the yearly incremental increase which manufacturers demand. The exact position of the wild, plantation, and what may perhaps be termed the pseudo-wild rubber supplies in the British Empire, and in islands and territories belonging to other nations, is difficult to ascertain, but I think it can be shown that in a very small fraction of the Indo-Malayan region, to say nothing of our West Indian islands or of the vast African territory, we are preparing to take an important and perhaps predominant position as producers of rubber from organized and well-kept tropical plantations. We have more than sufficient land available in the tropics to supply double or treble the amount of the world's consumption for 1906, and can already—barring unforeseen disaster—promise to supply from 12,000 to 25,000 tons of pure rubber from the acreages now planted in Ceylon, Federated Malay States, Borneo, South India, Java, and adjacent islands. The position is so strong and promising that one may be excused for believing that if the extension in rubber cultivation continues as it has done for the last few years, the ultimate condition of low prices and abundant production is not far distant; such changes will, however, be of much benefit to the industry. Wherever you go in the countries just mentioned, the one great topic which is commanding attention, energy, and capital, is that of the cultivation of rubber-producing trees, and but few other products can, in the tropics, hope to receive the consideration they deserve, until the rubber craze has been satisfied. The plantation rubber industry in the East has already made a good name, and no one who possesses an intimate knowledge of the present position and probable future developments, can deny that it has gone to stay. The success which has attended many ventures has arrested the attention of responsible officers in all parts of the world, and it will interest you to learn that thousands of seeds of *Hevea brasiliensis* were sent back to Brazil, from Ceylon, for planting purposes, during 1906, in addition to very large numbers of seeds and plants to Africa, West Indies, Borneo, Sumatra, Java, and parts of India, &c.

During my short stay in England, I have had the pleasure of meeting several rubber manufacturers, and my confidence in the plantation industry has been increased in consequence of the information they have given me, and their willingness to book forward contracts for the next ten years, at prices which will well repay the cultivators in the tropics.

Future Plantation Output.

Up to the present the cultivated trees have not supplied much rubber, but it is necessary to point out that five years ago this cultivation was not favourably viewed, and it is only in the last few years that the acreage has increased by leaps and bounds, out of all proportion to the gradual development of more remote years. We have seen that in Ceylon, from 1890 to 1898, the acreage only increased at the rate of about 50 acres per year, and in 1898 was estimated at approximately 750 acres; three years later rubber was planted on 2,500 acres, in 1904 it occupied 11,000 acres, in 1905, 40,000 acres, and last year, 100,000 acres; and similarly in other Eastern possessions. I again mention these figures to draw attention to the fact that the planting of rubber trees during the last two years in the Indo-Malayan region alone has been on a comparatively large scale, and that we may therefore expect to see a sudden increase in the amount of rubber on our markets a few years hence. Ceylon alone has already planted land sufficient to supply London with about 7,000 tons of rubber per year in place of the 70 tons she sent in 1905: land is being applied for and purchased at very high prices, and very soon a prominent and permanent position will be established. When one considers what has recently happened in Ceylon, the Federated Malay States, and India, it is obvious that the export in a few years will be as suddenly increased as has the planted acreage in these places, and for this we must be prepared.

Purity and Constancy of Plantation Rubber.

One of the outstanding features of the future plantation rubber industry will be its constancy, not only in output but in purity, and also probably in form and physical property. The acreage of each estate is usually well known, and the accuracy of the output per year will be guaranteed just as it is on mature estates of other products in the tropics. The consumers may rest assured that adulteration will never be adopted, first because there are no trees of such yielding capacity as those under cultivation, and secondly because the estates are mainly under the supervision of

Europeans who are only too anxious to establish a fair name for their produce; any changes in chemical and physical properties which may occur in the rubber exported in the future will either be due to a change in the mode of manufacture or to the increasing age of the tapped trees—two possibilities which suggest improvement rather than retrograde development. It is almost certain that the form of the future rubber will be one which will minimise the liability to oxidation and development of tackiness in transit, and one which will commend itself for ease in handling and shipment.

Improvements in physical properties are to be expected year by year as the trees grow older; what Europe and America are receiving to-day from plantations are only the worst and most crude samples of rubber, for the planters do not know what is really required—the industry is in its elementary stage, and all may rest assured that no efforts or expenditure will be spared which will help to place the cultivation of rubber trees on a sound basis.

Rubber Consumers and Producers.

There is one point which, while dealing with plantation rubber, I cannot omit to mention. I refer to the want of unanimity between producers in the tropics and consumers in Europe and America, to the lack of authoritative information from consumers as to what they wish their colonial producers to turn out. Planters in Ceylon, India, and the Federated Malay States, are very anxious to find out what form of preparation the manufacturers most desire, and the fact that within twelve months they have sent home their plantation rubber in the form of biscuits, sheets, crêpe, lace, flake, ribbons, balls, block, pressed scrap, washed scrap, hand-picked scrap, in the smoked and unsmoked condition, dry and wet, naturally and chemically coagulated, and in many other forms and conditions should be sufficient to indicate the manner in which they are endeavouring to meet whatever requirements may be stipulated. The producers desire to adopt methods which will enable them to dispose of the large volumes of latex speedily and to pack and ship the rubber with the greatest security and ease.

Will the manufacturers be good enough to state whether they prefer rubber which has not been obtained by the use of chemical re-agents, or if they object to the washing of the freshly-coagulated material? We should also like to know if they prefer to receive it free from moisture, in the smoked or antiseptic form, and whether they prefer rectangular thin sheets, thick blocks or biscuits. A definite statement from the consumers would be heartily welcomed by the producers, it would obviate much waste of time and money, and lead to the establishment of definite standards for exports at an early date.

Effect of Rubber on other Cultivations.

The planting of rubber trees necessitates the destruction of the original forests, but sooner or later a new forest takes the place of the old. The cultivation of rubber vines (*Landolphia*) does not incur the destruction, but demands the retention of a part of the original forests, as the vines must have some means of support, such as stems along which they can climb. Rubber cultivation is therefore fundamentally different from that of tea, cotton, camphor, &c., and in many cases leads to the re-afforestation of lands which have been allowed to lapse into waste compounds or chena land.

The extensive cultivation of rubber trees will directly affect many other products cultivated in the tropics. At the present time *Hevea brasiliensis* is being largely planted among tea in Ceylon and South India, among coffee in Sumatra, Java, and South India, and among cacao in Ceylon. *Castilloa elastica* is being extensively grown with cacao in the West Indies, and to a small extent in Ceylon. *Ficus elastica* is grown with coffee in Sumatra. The distance of the rubber trees from one another is generally such that the intercrop of tea, coffee, and camphor will ultimately be choked out, and only in the case of cacao does the combined cultivation appear to be of a more or less permanent character. Furthermore, there are vast areas in the Federated Malay States where cassava or tapioca and gambia are grown on the land as soon as the jungle has been felled and cleared. In Ceylon, minor crops of chillies, hill paddy, bananas, tapioca, lemon grass, and citronella are cultivated; in other countries, tobacco, indian corn, and other plants are grown on new land. These areas are now being rapidly interplanted with rubber trees which, once they have reached maturity, will not permit of the cultivation of the intercrops and catch crops, which are of such importance to natives and commerce generally. In some countries, where the faith in rubber alone has not yet taken a very firm position, the majority

of the lands already under other products, are being interplanted with rubber species.

In Ceylon, during the last few years, a large area of the poorer low-country tea has been interplanted with *Hevea brasiliensis*, and there can be no doubt that in three to five years time the greater part of such tea will no longer be plucked; the same may be said of much coffee in Southern India, and in various Indo-Malayan regions. Now, however, the tendency appears to be to plant *Hevea brasiliensis* as a single product, when land is available. Though this is the case with tea and coffee, the effect on cacao in Ceylon appears to be the reverse. In the Matale, Dumbara, Kurunegalle, and other districts of Ceylon, *Hevea brasiliensis* and cacao (or cocoa) are being largely planted on new clearings as a combined cultivation; the plants are generally distanced so that there are about 100 rubber and 100 cacao plants per acre; under such conditions, both appear to thrive for many years, and to yield fair harvests in the fifth or sixth years.

Land planted in coconuts is usually not interplanted with rubber plants, though in one country coconuts have been felled and removed to make room for the rubber trees.

Camphor as an intercrop among rubber is, in the tropical parts of the British Empire, as yet only in the experimental stage.

To sum up the effect of the combined cultivation, we may say that much tea and coffee will be killed out, the acreage in cacao increased, and the available land for catch crops of oil grasses, bananas, chillies, &c., be ultimately permanently reduced.

Laticiferous and Caoutchouc Plants.

It is necessary to explain that numerous plants possess latex in large quantities, but the viscous liquid is often almost useless on account of the low percentage of caoutchouc or the high percentages of albuminous, resinous, and other substances present. Everyone must have noticed the milky liquid which issues from the cut surfaces of *Sonchus arvensis* and species of *Euphorbia* plants which occur abundantly in parts of England; in the tropics there are many plants, such as species of *Carissa* and *Plumeria*, *Euphorbia Tirucalli*, *E. Antiquorum*; climbers or lianes, *Cryptostegia grandiflora*, *Willughbeia zeylanica*, which almost squirt out large quantities of latex when cut with a knife. The same may be said of *Palaquium* and *Bassia* in Ceylon—genera from which the gutta percha of commerce is obtained, but which in the island mentioned yield latex of very little commercial value. The latices of importance usually possess high percentages of caoutchouc—the compound which largely determines the uses to which the dried product can be put. "If one considers species of the same genus, the striking fact is revealed that the chemical composition of the latex is almost of specific importance. There are many species of *Hevea*, *Landolphia*, *Ficus*, and *Funtumia*, but only certain members possess high percentages of caoutchouc and low percentages of resins and proteids.

The Laticiferous System.

All the species which have been previously mentioned are characterised by systems of sacs, series of cells, or tubes containing latex; these occur in nearly all parts of the plant. The commercial possibilities and the ultimate success of several species are determined by the particular type of laticiferous tissue which each contains; each type requires to be dealt with in a particular manner: it is very dangerous to adopt the same methods of tapping for all species. The principles of paring and pricking the primary and renewed cortex should be studied more seriously and intelligently than they appear to be at the present time. When one considers the great difference in the nature, mode of origin, and development of the laticifers in various plants, there is every reason for suggesting that each species should be tapped on a particular system in order to take advantage of the peculiarities of each type. These remarks are made because there is a tendency among responsible persons to recommend or adopt for their *Castilloa*, *Manihot*, *Funtumia*, *Landolphia*, and *Ficus*, plants, the system of tapping which has been found to be so successful with *Hevea brasiliensis*. From a study of the laticiferous system of our prominent plants, I am convinced that in certain instances the old native, and apparently wasteful, methods adopted in the extraction of latex are probably as good as, and even better than, many which have been evolved.

The laticiferous system in several of our important species occurs in the cortex of the stem, branches, roots, and in the leaves, flowers, and fruits. In some species the laticifers appear to be best developed in the root, and the extraction of latex is only considered in relation to that part; in other species there appears to be a better develop-

ment in the stem, and in a few others the flowers or young twigs show conspicuous developments. Generally, these structures and the latex appear in the embryo and remain until the death of the plant; in some cases, however, the laticifers are not obvious except in plants of some years' growth. Sometimes they are absolutely restricted to stem and roots, the leaves and flowers never being in possession of such structures; in a few cases they appear in the young tissues, and then gradually die and disappear.

For the purposes of this paper it will perhaps be sufficient to state that there are three types of laticiferous systems, the components of which are scattered freely throughout the cortex in the stem; they may, according to their age and the condition of the plant, be partially or wholly filled with latex. When the cortex is incised the latex escapes, the quantity thus issuing depending largely upon the structural relations of the laticifers and the moisture conditions. A given incision allows the latex to issue only from a local area, dependent in extent upon the nature of the laticiferous system being tapped; generally several, and sometimes a very large number of, incisions may be made on the basal part of the stem.

Collecting Latex.

The latex is usually obtained by making incisions in the cortex of the living plant, and placing receptacles beneath each incision or groups of incisions; this method is in use in the extraction from tree forms, such as *Hevea*, *Castilloa*, and *Funtumia*, and also from some vines of the *Landolphia* type. When the plants are small (*Parthenium argentatum*), or when the latex is concentrated in the roots (*Landolphia Thollonii*), the latex is not usually extracted as such, but is allowed to dry within the plant tissues; the residual rubber is obtained therefrom by a process of steeping and softening the tissues in water or certain solutions, and subsequent maceration. A sample of *Landolphia* rubber thus prepared has been kindly sent by Mr. Johnston for your inspection.

In collecting the latex from living trees, several systems are in vogue. In some parts of Africa and America, the natives fell the trees, and after having placed the trunk in a proper position, ring it at definite intervals along the length of the stem; they then collect the latex issuing from each cut in a receptacle made of leaves or some other convenient or common article. The more intelligent natives make incisions in the basal part of the stem with a heavy hatchet, or large knife, and allow the trees to remain standing in order that at some subsequent date they may be again tapped. In some parts of Mexico, the natives appear to believe more in the tapping of the higher parts of the Castilloa trees; an illustration showing a Mexican at work, is shown on the screen. In some parts of Mexico, even skilled Europeans appear to have recourse to the use of large unwieldly knives with which a heavy blow may be inflicted. Apparently the methods adopted in the collecting of wild rubber are not based on the preservation of the trees or vines, and even when the exploited forests are under skilled supervision the bark is often severely bruised and the cambium layer more or less destroyed in local areas; the object in both cases appears to be the extraction of as much latex as possible from each tree in a single day or with the minimum expenditure of labour.

Methods on Eastern Plantations.

On the other hand there can be no doubt that the rubber planters on Eastern estates, whose work is being closely followed and minutely imitated by visitors from many parts of the world, are striving to obtain satisfactory yields of latex by systems which allow the trees to remain in a healthy and vigorous state. The labour conditions prevailing in our Eastern possessions are such that very careful work can be cheaply done. The fact that each coolie is provided with paring and pricking knives and is capable of effectively tapping 40 to 200 trees as his daily task, is sufficient to indicate the shortness of the duration of the daily tapping operation on each tree. In the jungles possessing indigenous wild and scattered trees it is often impossible for the coolie even to walk the distance separating ten or twenty scattered rubber trees as a daily task; consequently, when a wild rubber tree is found the coolie does not lose sight of it until he has extracted the maximum amount of latex from it.

On Eastern plantations the objects are (1) to treat the trees very lightly each day; (2) to irritate only the first five or six feet from the base; (3) to avoid too rapid excision of the bark; and (4) to obtain the latex from the innermost and more abundant laticiferous channels without unduly damaging the cambium or healing layer of the stem.

Systems of Tapping.

The systems of tapping now in vogue are numerous; they include the ordinary and basal V, inverted V, single oblique, half herring-bone, full herring-bone, half-spiral, and full spiral systems. The lines in each system usually incline at an angle of 30 to 45 degrees, and are distanced approximately twelve inches apart. Most of these systems are planned out on several or four sides of each tree, and one part or side is tapped on successive days; the full spiral system is the only one which completely taps the whole of the cortex. When the tapping areas, on each of the four sides of a tree, are disposed so as to face north, south, east, and west, compass tapping is often adopted. On badly tapped trees, or those with irregular gnarled surfaces, a zigzag system is necessary in order to secure a gradual slope of each line between the knots. The V system was largely adopted in the early days, and is among one of the oldest known; the inverted V, basal V, and the full spiral systems are the most recent; the half or full herring-bone principle appears to be more frequently adopted than any other system. The full spiral system gives very large yields, but if the tapping is carried on too rapidly it may endanger the health of the tree, and involve considerable waste of cortical tissues.

Frequency of Tapping.

The frequency of tapping operations is generally largely determined by the labour and supervision available, and as far as *Hevea brasiliensis* is concerned the greatest fear is that when once the large acreages are in bearing there may be some difficulty in obtaining the labour necessary to take full advantage of the yielding capabilities of the trees. The illustrations show the condition of the trees after they have been tapped every day, every alternate day, twice per week, once per week, once per month, and so on, for a period of eleven months. It is a curious fact that tapping every day may give lower yields than tapping every alternate day on account of the too rapid excision of the cortical tissues wherein the laticiferous channels develop day by day. The following are some of the results obtained up to the time of my departure from Ceylon, in January last, at the Henaratgoda Garden. There were five trees of *Hevea brasiliensis* in each group, and all were tapped on the full spiral system; the trees were alternately pared and pricked during the period under experiment, and were twenty-nine to thirty years old:—

Frequency of Tapping.	Number of times tapped.	Yield of dry rubber, per tree. lb.	oz.
Every day	354	12	8
Every alternate day	177	14	3
Once per week	64	6	1
Once per month	15	0	12

The tapping operations were carried out during ordinary working days, excepting Sundays and times of flood, &c., in order to make the results applicable, as far as possible, to the conditions obtaining on the average rubber estate. The tapping of the trees in the first two groups — every day and every alternate day — was suspended for a short period, but the trees in the other groups were tapped for fifteen months. These results should only be viewed in a very general manner, but the danger of too frequent tapping is manifest from the above series.

The frequency of tapping should theoretically be determined by the wound response and ease of the flow of latex, but practically a system must be devised which, while it may involve a little waste of cortical tissue, will allow one to employ the labour on estates regularly, and thus obviate a greater waste of expenditure or general disorganisation. Though the proprietors of several rubber plantations are fully aware of the value of periodicity in tapping, they are compelled to adopt methods absolutely opposed to all plant requirements, and some anticipate only being able to tap sections of their properties in successive years, instead of each tree every alternate day.

Frequency and Response.

Regarding this subject of frequency or periodicity in tapping it is interesting to recall the results of certain experiments with *Hevea brasiliensis* and *Manihot Glaziovii*. When *Hevea brasiliensis* is first tapped the flow of latex is often insignificant, but on re-tapping in approximately the same area it is noticed that the yield of latex gradually increases until the maximum is reached. This was, as far as my knowledge goes, first clearly determined by Parkin, in Ceylon, and has been since confirmed in Java by Dr. Tromp de Haas, and by Mr. Stanley Arden, in the Federated Malay States. This wound response in *Hevea brasiliensis* is explainable if we imagine that repetitional tapping or irrita-

tion in the same area leads to a distended condition of the latex tubes which, being in communication with neighbouring channels of the laticiferous system, become charged to their maximum extent and consequently give a higher latex yield. The wound response is obvious after 24 hours, and may become more pronounced day by day until the maximum may, according to Parkin, be reached on the 14th day. When the laticiferous channels have been drained of their contents an interval of time must elapse before they can be expected to yield the largest quantities of latex. The same experiments have been made with some twenty-year-old trees of *Manihot Glaziovii*, but have not been accompanied by the same results.

Coagulation.

The latex obtained from the plants is rarely exported as such; it is usually subjected to some treatment which ensures the removal of the greater part of the water. The methods employed in different parts of the world show a great variation, and are often founded on opposing principles. Most of the processes in vogue at the present time involve chemical changes of certain original constituents of the latex, a few enable the operator to separate the caoutchouc by mechanical means—in which cases chemical changes are either entirely stopped, or only allowed to continue for a short time.

The fresh latices may be neutral, acid, or alkaline in reaction; they consist essentially of a liquid in which caoutchouc and other globules are held in suspension, and other substances in solution. When latex has been coagulated, the caoutchouc globules form an irregular but connected network which encloses certain resinous and albuminous matter; by the contraction of the caoutchouc the water with some of its dissolved substances is expelled.

Coagulation often takes place as soon as the latex is exposed to air; other latices will remain much in the original condition for several days. Latices, which are liable to undergo putrefactive changes on exposure to air, may sometimes be prevented from coagulating by the addition of formal, which prevents decomposition, or by the addition of ammonia which neutralizes the acids as soon as they are produced. In the simplest cases, coagulation is effected by allowing the latex to stand in circular or rectangular receptacles until decomposition sets in and a strong acidity is developed; sometimes the caoutchouc globules, owing to their being lighter than water, can be separated from the other constituents by centrifugal machines; the addition of water alone, or of aqueous solutions of heavy sodium salts, is often sufficient to cause the light globules of caoutchouc to rise to the surface. Some latices can be coagulated by boiling, or by the application of heat. In many cases, however, the latices are treated with chemical re-agents of an acid, alkaline, or alcoholic nature, or with acid and alkaline plant juices. The Amazon method of preparing fine hard Para rubber from the latex of *Hevea brasiliensis*, partly depends for its success on each thin particle of rubber being impregnated with small quantities of acetic acid and creosote. On plantations of *Hevea brasiliensis* small quantities of acetic acid are used to hasten coagulation, and the use of coagulating reagents possessing antiseptic properties is also receiving much attention in the East.

It is impossible in one paper to give the details of the operations which are being carried out in the preparation of rubber from latex in all parts of the tropics. This has been dealt with elsewhere.* It is sufficient to know that the latex can usually be rapidly converted into rubber ready for export. Most of the wild rubber arrives in Europe in a very wet state, but that from plantations is usually nearly dry; the former condition leads to a wavering in the price of the raw material, since the water contents are liable to great variation. The wild rubber, as you can see by the specimens on exhibition to-day, arrives in many forms, but that from plantations in the East is usually in the form of crêpe, sheet, block or biscuit, and of a high standard of purity.

Yields.

The yield of rubber obtainable from the different species under cultivation is a subject about which much has been said: it is on this factor that the success of the rubber industry rests. It is perhaps too early to make any definite statements on this subject, especially with reference to the yield obtainable from wild trees and vines of doubtful age, and growing under conditions the significance of which is but little understood. An annual yield of one pound of dry rubber per tree is, perhaps, above the average for plantation trees of *Manihot* and *Castilloa*; a yield of

* See "*Hevea brasiliensis*; its botany, cultivation, chemistry, and diseases:" Messrs. A. M. and J. Ferguson, Colombo, 1906.

two pounds per tree has been reported for trees of *Funtumia elastica* in the wild state, and annual yields of a few ounces, per vine, for certain wild *Landolphia* plants have been estimated. We have, fortunately, some information regarding the yields obtainable from trees of *Hevea brasiliensis* on Eastern plantations. Generally, the maximum yields of rubber are obtained during the first series of tappings; subsequent tappings may give poorer yields, though each tapping operation involves an equal excision of the bark. It will be quite obvious that the very best results with the minimum waste of cortex and of labour will be accomplished by taking full advantage of what may, perhaps, be termed the replenishing periodicity of the laticiferous channels. The results show that to tap too frequently may not only lead to a great waste of money in labour expenditure, but actually to a reduction in the total amount of rubber obtainable from the tapped trees; they further show that by tapping at certain intervals and allowing certain periods of rest very large quantities of latex, with very little expenditure of cortex or coolie labour, may be obtained. The best periodicities have not yet been determined, but sufficient has been said to indicate that such exist and deserve every consideration; all that can be said at present is (1) it may be dangerous to tap every day throughout the year; (2) tapping on alternate days throughout the year may give higher total yields per tree than tapping every day; (3) tapping the same area from 3 to 14 days in succession, in the case of *Hevea brasiliensis*, considerably depletes the laticiferous system; (4) tapping the same area daily for two or three weeks in succession partially depletes the laticiferous system of *Manihot Glaziovii*, and a rest must be given or fresh areas tapped. The results at present available indicate how valuable economic botanical investigations in the tropics may be to cultivators, and though it may not be commercially possible to conduct operations exactly which appear to be desirable from the purely scientific standpoint, yet I feel sure that the principles will ultimately, either partially or wholly, become an integral part of the daily operations on the best conducted plantations.

Future Yields from renewed Cortex.

The yields with which we have previously dealt, and on which the hopes of the future have been largely based, have been obtained by tapping the original coxtex; success in the future depends, however, on the yields obtainable from the renewed bark. In the more modern and systematic methods of tapping it is customary to repeatedly pare the lower surface of each sloping cut until nearly the whole of the original cortex has been excised. The innermost part of the cortex and the cambium are not intentionally excised; the cambium layer, by the division of its cells, gradually produces new cortical tissue from within outwards; sometimes when the cambium has been severely damaged new cortical tissue is produced from above downwards, in a conspicuous manner, and the addition of new cells from within outwards, only occurs when the injured region has been completely repaired. On some estates the cortical stripping round the whole of the tree has been effected in one year, and fair yields have been obtained from renewed cortical tissue which was only one year old. It has been demonstrated, however, that tapping young renewed bark is not always advisable; normal latex possesses about 50 to 60 per cent. of water, but that from renewed bark, only one year old, may under certain conditions possess as much as 90 per cent. of water and very little caoutchouc; furthermore, too frequent paring of the cortex will impair the vigour of the tree, and may result in early decay and death. At the present time the cortical tissues are removed at different rates, many planters cutting away the whole of the tissue between the parallel tapping lines, originally distanced twelve inches apart, in one year. It has been shown, however, that a tree may be pricked and pared on about ninety occasions in one year, and yet only three out of the twelve inches of bark between parallel cuts be removed.

Tapping at the rate of three inches per year, even on the full spiral system, a period of four years would elapse before the whole of the original cortex would be removed; this would allow a sufficiently long period for the new cortex to mature. If this is adopted a continuance of satisfactory yields may be expected; if it is not carried out, one can only expect a latex rich in water, and inferior, if not dead, trees.

Yields from Young and Old Trees.

The main factor on which the rubber industry depends is the yield of rubber obtainable, and the period over which it can be guaranteed. It is satisfactory to be able to state that the yields already obtained from Para trees varying

in age from 4 to 30 years are such that the industry may be expected to be able to withstand a very serious reduction in the price paid for the raw material. The cultivated trees can be first tapped when they have a circumference of twenty inches a yard from the ground, and may be tapped more or less continuously for the rest of their lives. Young trees are known which in the first year of careful and light tapping have given 4 to 16 ounces of dry rubber; trees from six to thirteen years old have given 2 lb. of rubber in one year, others eight to fifteen years have given 3 lb. in one year, and some of the very oldest trees at Henaratgoda have yielded as much as 15 lb. of rubber in eleven months. Naturally, the yield varies according to the system of tapping adopted—whether by the V, spiral, or herring-bone, &c., or whether paring or paring and pricking are adopted; it also varies according to the age and vigour of the trees and the part of the stem tapped. Generally, only the first five or six feet from the base is tapped, but on several estates where labour is plentiful and a few old Para trees exist, the latex is collected from the base up to ten, fifteen, and twenty feet. In the year 1905, a certain 198,000 trees, varying in age from four to twenty years, but mainly six to nine years old, were tapped and gave 246,800 lb. of rubber, or over one lb. per tree per year. In 1906, from the figures already available, this return is likely to show a good increase. From these and other considerations an average annual yield ranging from one to three lb. of rubber from mature trees appears possible, providing the constitution of the plant is understood and tapping operations are carried out in a scientific manner.

The outturn per acre can, of course, be easily calculated, and a Table is here given showing the output according to the distance the trees are planted and the yield obtained:—

Approximate Yield per Acre.

Distance.	Number of trees per acre.	¾-lb. per tree.	1-lb. per tree.	1½-lb. per tree.	2-lb. per tree.	3-lb. per tree.
(feet.)		lb.	lb.	lb.	lb.	lb.
10 × 10	435	326	435	652	870	1,305
10 × 15	290	217	290	435	580	870
15 × 15	193	145	193	289	386	579
15 × 20	145	109	145	217	290	435
20 × 20	109	82	109	163	218	327
20 × 25	87	65	87	130	174	261
25 × 25	70	52	70	105	140	210

Exceptional Yields.

The reports of yields which have been obtained from trees of *Hevea brasiliensis* in Ceylon and the Federated Malay States have been discredited, especially by persons who have been tapping trees other than *Hevea*. In my opinion no records which I have seen have depicted impossible yields, and knowing from experience the yield of rubber obtainable per unit of excised bark by all the systems of tapping, and from various sections of the stem, I feel inclined to the hope that once we understand our plants, much better average yields may be obtained. The largest yield which I obtained in Ceylon was 15 lb. of rubber from one tree 29 to 30 years old, in 11 months; it was my belief, confirmed by a few score men of experience who visited the tapped trees at Henaratgoda, that it would have been easily possible, at the sacrifice of the tree, to obtain three times the amount from the specimen in question.

Yield According to System.

It is necessary to point out that the yields procurable by the full spiral system represent those obtainable when the cortex around the whole of the stem is tapped; on the other hand, the yields for other systems usually represent those derived from a fraction or one side only of each tree, and are such that they may be expected to be more continuous over successive periods when the alternative sides are tapped in turn. On the herring-bone system, for instance, one out of four available sides may be tapped for one year and the other sides tapped in successive years. It is unnecessary to give the yields obtained by each system and per unit of excised bark, as these have been published elsewhere.

Latex from Different Sections.

Some laticiferous plants yield rubber of good quality when quite young, but this cannot be said of the *Hevea*, *Castilloa* or *Manihot* species in Ceylon. The cortex of the seedling of *Hevea brasiliensis* and the cotyledons of the seed itself possess a large number of laticiferous channels, but the latex obtainable therefrom is usually very sticky and the dried product of low commercial value. Rubber prepared from two-year-old trees of *Hevea brasiliensis* is sticky and easily snaps when lightly stretched; that from four-year-old trees or from stems which have a circumference of about twenty inches, though it does not possess the properties which

manufacturers most desire, realises a price which is, to the producers, satisfactory. When a tree is tapped for the first time, though it may be 4 or 29 years old, the rubber obtained from the latex is apt to turn soft, sticky, or tacky on keeping; this is usually accounted for by the large proportion of sap contents which are unavoidably mixed with the latex when the original incisions are made, the sugars, gums, &c., from the cortical cells providing a good food supply for bacteria responsible for the development of tackiness in rubber. Subsequent tappings of trees of these dimensions usually give good rubber when the tapping operations are carried out on the basal part (base to 5 or 6 feet); it is curious, however, to note that when the higher parts of old trees are tapped the latex obtained is often changed in constitution. The latex from high parts is often very watery, and possesses a low percentage of caoutchouc; on treatment with the requisite quantity of acid, coagulation does not take place; even when allowed to stand for several days a curdled liquid only is obtained, the particles of which are not elastic and do not adhere to one another.

Height of Tapping Area.	Number of times tapped.	Number of times when latex not coagulable.	Per cent. of tappings giving non-coagualable latex.
Base to 5 or 6 feet..	1,165	9	0·77
„ 6 to 16 feet..	95	1	1·05
„ 10 to 20 feet..	94	1	1·06
„ 20 to 30 feet..	94	2	2·12
„ 30 feet	171	24	14·03
„ 50 feet	84	5	5·95

The number of times when non-coagulable latex has been obtained from various sections of the stems of 29-year-old trees is given in the table, and in considering them one should remember that the circumference of the stems at the highest points tapped was not less than 30 inches.

Labour and Yields on Small and Large Plantations.

Owing to the co-operation and courtesy of the planting community in Ceylon, South India, and Malaya, I have been able to collect a considerable number of figures showing the yields on small and large properties for a few years in succession, and am enabled to bring a few general conclusions before you to-day. The most important fact which I wish to mention is that the yields obtained from the same trees in successive years have shown a slight increase; this is especially true in those cases where the tapping operations have not led to too rapid excision of the cortex. But though this is correct for small and some large estates, and though certain small properties have shown a very large increase per tree, yet the yield per acre on some plantations possessing a very large number of mature trees has shown a reduction. The cause for this reduction is that a large acreage has been tapped whenever labour permitted; sometimes only sections of the estates have been tapped, and in such instances each tree has not received the attention which those on smaller properties have. Sound trees of *Hevea brasiliensis* will stand tapping every alternate day throughout the greater part of the year, and while several friends assure me they are able to do this at present, others are equally emphatic on being unable to adopt such frequent tapping.

List of Samples of India Rubber, Collected by Messrs. Edward Till & Co., Exhibited at the Meeting.

No.		Whence.	General Notes on Characters.
1.	Lent by Edward Till and Co.	Africa.	Sierra Leone Red Niggers
2.			Assinee Niggers
3.			Manoh Twists
4.			Grand Bassam Cake
5.			Hansa Cake
6.			Ivory Coast Niggers
7.			Gambia Niggers
8.			Congo Ball
9.			Cameroon
10.			Benguela
11.			Grand Bassam Roots
12.			„ Niggers

No.		Whence.	General Notes on Characters.
13.	Anglo-Malay Rubber Co. Ltd.	Straits.	Sheet.
14.	,, ,, ...	,,	Fine Pale Crepe.
15.	,, ,, ...	,,	(1) Crepe.
16.	,, ,, ...	,,	(2) ,,
17.	,, ,, ...	,,	(3) ,,
18.	Cicely Rubber Estate	,,	Sheet.
19.			
20.	Batu Tiga Rubber Co. Ltd.	,,	Biscuits.
21.	Gikiyanakanda Rubber Estate	Ceylon.	Fine light worms.
22.	,, ,, ...	,,	Worms, block.
23.	,, ,, ...	,,	Biscuits.
24.	,, ,, ...	,,	(1) Crepe.
25.	,, ,, ...	,,	(2) ,,
26.	,, ,, ...	,,	(3) ,,
27.	Kuala Lumpur Rubber Co., Ltd.	Straits.	Fine Pale Crepe.
28.	Kepitigalla Rubber Estate	Ceylon.	Sheet.
29.	,, ,, ...	,,	Biscuits.
30.	,, ,, ...	,,	Virgin Block.
31.	Labu (F. M. S.) Rubber Co., Ltd.	Straits.	Sheet.
32.	,, ,, ,, ...	,,	Crepe.
33.	Lanadron Rubber Estate....................	,,	Fine Block.
34.	North Borneo Trading Co., Ltd.	,,	Sheet.
35.	Pataling Rubber Estate Syndicate...........	,,	(1) Crepe.
36.	,, ,, ...	,,	(2) ,,
37.	,, ,, ...	,,	(3) ,,
38.	K. M. A.	,,	Fine Sheet.
39.	,, ...	,,	Fine Block.
40.	Rubber Plantations, Ltd.	Ceylon	Light Biscuits.
41.	,, ...	,,	Dark ,,
42.	Selangor Rubber Co., Ltd. (Sungei Rengan	Straits	Sheet. (From $8\frac{1}{2}$ year old trees).
43.	Estate)	,,	No. 1 Crepe.
44.	,, ...	,,	No. 1 ,, (Prepared with creosote).
45.	,, ...	,,	No. 1 Scrap.
46.	,, ...	,,	Crepe. (Prepared from Scrap collected off trees).
47.	,, ...	,,	Crepe. (Prepared from Bark shavings).
48.	Heatherley Rubber Estate	Ceylon	Biscuits.
49.	,, ...	,,	Crepe.
50.	Yataderia Tea Co. of Ceylon	Ceylon.	Biscuits (Thin).
51.	,, ,, ...	,,	,, (Thick).
52.	,, ,, ...	,,	Scrap.
53.	,, ,, ...	,,	Block Scrap
54.	Eastern Produce and Estates Co.	,,	Amber Biscuits (Thin)
55.	,, ,, ...	,,	,, (Thick).
56.	,, ,, ...	,,	Smoked Biscuits (Thin).
57.	,, ,, ...	,,	,, (Thick).
58.	,, ,, ...	,,	Scrap.
59.	,, ,, ...	,,	Block Scrap.

Exhibited by :—

Messrs. S. Figgis and Co.—

Collection of samples of rubber as follows:—

1. Fine Para Rubber.
2. Peruvian Ball Rubber.
3. Mattagrosso Virgin Rubber.
4. ,, Negroheads Rubber.
5. Uganda Plantation Sheet Rubber.
6. ,, Pears Rubber.

Messrs. S. Figgis and Co.—

7. Sudan Ball and Sausage Rubber.
8. Congo "Cherries" Rubber.
9. Plantation Straits Sheet Rubber.
10. ,, Pale Crèpe Vallombrosa Rubber.
11. ,, Brown Crèpe Pressed Block Rubber.

Imperial Ethiopion Rubber Co.—

Sample of Vine rubber from Abyssinia, supposed to be "Landolphia Kirkii."

Exhibited by:—

Messrs. Lewis and Peat—

Samples of Plantation Rubber, in sheets, biscuits, crêpe, lace, &c., from Ceylon Estate.

Samples of Plantation Rubber from the West Indies, Assam, and Malaya.

Block of smoke-cured Biscuit Rubber from the Amazon.

Collection of Knives and Tools used in Rubber Industry.

Collection of Photographs illustrating Growth and Curing of Rubber in Ceylon and Brazil.

Messrs. Little and Johnson—

Collection of samples of rubber from the Congo State.

Messrs. Spence, Wallis and Co.—

Samples of Para biscuit, Ceylon rubber (Duckwari Estate).

Mr. Herbert Wright—

Samples of Latex from Ceylon with Coagulated Rubber from the same.

DISCUSSION.

The CHAIRMAN, in opening the discussion, after congratulating the author on the production of such a comprehensive paper, thought there was little to be said regarding the Manihot mentioned by Mr. Wright as cultivated in South America, which was not the same as Ceara rubber. It seemed to be well known in Saô Paulo, Southern Brazil, far to the south of Ceara, but it was not there considered to be the same as the Ceara rubber tree. Seeds of the same Manihot had been sent from Bahia, midway between Ceara and Saô Paulo. When sent from Bahia the seeds were termed Maniçoba, a name which was usually associated with the Ceara rubber tree *Manihot Glaziovii*. The use of the name Maniçoba at Bahia for that *Manihot* might mean that it was there thought to be the Ceara rubber tree. But it certainly was not *Manihot Glaziovii*, and it might be that in these two different Brazilian States the same name was applied indiscriminately to two different trees The botanical name of that species was not yet known; nor was it known how its rubber compared with that of *M. Glaziovii*. Those who recalled what happened in Ceylon, when leaf-disease attacked coffee, would ask whether rubber was necessarily exempt from the dangers to which other exotic crops were liable. People were more alive now to such possibilities than they were a generation ago; and it was now more generally recognised than it was, that what was spent in securing the services of good plant-pathologists was a sound form of insurance against such risks. Planters were now prepared to act, and act promptly, on lines laid down by competent advisers, should such a visitation occur. But in spite of all that was known, and could be done, there was even yet no absolute guarantee against sudden and overwhelming calamity. With regard to rubber such a visitation was not inevitable; considering the precautions that planters now took, it was perhaps unlikely. But it was not impossible. It had quite recently been reported that the cultivation of one particular rubber in Ceylon was impossible, owing to its liability to attack by an insect pest. Those who knew what had occurred in India since "synthetic" indigo first appeared into the market would equally ask whether rubber was necessarily safe against a like experience. The misgivings of some took the form of warm protests when the possibility was hinted at by their chemical brethren. It was not a foregone conclusion that chemistry would succeed in preparing artificial rubber on a commercial scale, nor was it certain that if "synthetic" rubber became an article of commerce "natural" rubber would cease to be required. But it was known that artificial rubber had actually been produced, and if the only instance of it so far recorded was in a sense accidental, one might be assured that chemistry would not rest content until that experience had been repeated, systematised, and if possible elaborated for commercial purposes. There was another risk which would be in the minds of all who were conversant with the story of cinchona cultivation in South-eastern Asia They might anticipate that if the extension of rubber cultivation continued as it had done for the last few years low prices and abundant production were not only possible but probable. The author had said that the change would be of much benefit to the industry. He (the Chairman) was connected for a considerable period with the cinchona industry, and his connection with that industry had been somewhat peculiar, because he had to act simultaneously in the three-fold capacity of planter, bark purchaser, and quinine maker. The question of benefit owing to low prices and abundant production he thus came to learn at first hand, was one that depended largely upon the point of view. The difficulty was that most movements were progressive, and it was not always easy to draw the line between abundant and superabundant production. There was, perhaps, less difficulty in drawing the line between prices that were not and prices that were too low. When that line required to be drawn, the producer had seriously to consider if it was worth his while to go on. That was a contingency that had to be kept in mind, and, in time, to be faced.

Mr. R. K. GRAY said the author had dealt in his paper with a subject which was of very great importance to many people in this country, but he agreed with the Chairman that it was necessary to give a warning in connection with it. Although he himself was a manufacturer, and would like to se

low prices, he did not like to see people get into too much of a fever when they had a good thing. He remembered some thirty or thirty-five years ago urging some friends of his in the East to go in for rubber planting, and he pointed out to them, what had been since proved to be correct, that rubber planting was not at all a question of planting trees but of organisation. When tea and coffee planting failed to be remunerative, proper organisation was instituted, and it was certainly to the credit of tea and coffee growers that they should have started a new production which was conferring and was going to confer in the future a very great benefit on the rubber industry. It was a very different thing, however, where people went into a business with a good organisation as the stand-by, and where others went into it purely because there was some ground to be bought and plants to be planted. He desired to draw attention to the point, because he was very much interested in the rubber industry, and he would not like to occur in the rubber planting industry what had happened in other industries with disastrous effects leading to a discrediting of perfectly legitimate and profitable undertakings. Very excellent business was to be done in rubber estates, but when these had to be sold to an investing public, organisation as well as ground and plants should be included in the bargain. Manufacturers who had been in the rubber business for many years did not go into the rubber-growing industry, not because they did not believe in it, but because they thought it was more an affair for the Government than for private individuals. It was interesting to hear, and he thought it was to the credit of this country, of the large extension of rubber planting that had taken place in the East, because he thought that the extension had been very largely due to the Department at Kew. Some people—he amongst them—were wont to criticise Governmental Departments in this country for wasting money; some Departments were always being pitched into, and it was a great pleasure to him to be able to say that the extension of the rubber industry abroad was in a large measure due to the Department at Kew. Those who read Mr. Wright's paper would find a great deal of instruction in it, and it was hardly possible to criticise what an authority like Mr. Wright had said.

Mr. Fritz Zorn thought the planters of Ceylon had always shown themselves great sportsmen in the way in which they had taken up rubber cultivation. because it was to be remembered that comparatively few years ago the men who started planting rubber were looked upon as visionaries and laughed at. He was very glad that a note of warning had been struck by the previous speaker because it was very necessary. At the present time some of the older rubber companies were showing the first fruits of their enterprise, two of the most mature companies having recently announced dividends for the year of 40 per cent.; but there was the danger that, with such large profits being shown, companies of a very different description might be placed before the investing public, and thus bring into disrepute an industry which ought to be a great one for those engaged in it. He thought it would also be of value if the author could state whether considerable danger might exist from the possible disease of the rubber plant. The question of the production of artificial rubber was one which might be easily exaggerated. Synthetic rubber must be produced at a price which would enable it to compete with plantation rubber, and he believed he was correct in saying that the latter, as it was grown now or would be grown in the course of a few years, could be produced at a cost roughly of 1s. a lb., so that unless artificial rubber could be made at a less price, the planter had nothing to fear. Another most important point was that, even if a completely satisfactory artificial rubber were made by chemists to-morrow, it would take a number of years to ascertain whether it possessed that most necessary quality of natural rubber, namely, durability. The archway under Euston Station was paved 18 years ago with a rubber composition, and during that time it had only worn to the small extent of five-eighths of an inch. It had been clearly demonstrated that, compared with wood, asphalte, and pavings of that description, rubber worked out much cheaper in the long run because of its enormous durability. If artificial rubber was produced, it would not be possible to demonstrate for many years whether it was durable, so that it would, therefore, only very slowly displace the natural article. The parallel employed by the Chairman with regard to cinchona and the fall in price was scarcely typical of rubber, for the reason that the latter was now standing at a remarkably high price compared with a few years ago; and if the price should fall from its present figure of 5s. to 4s. or 3s. 9d., there were many purposes for which rubber would be immediately employed for which, at its present price, it was far too expensive. If, on the other hand, cinchona bark were to fall very heavily in price, there were not many purposes for which it could be employed other than those for which it was already used; whereas, if the price of rubber fell, it could be used for road paving and numbers of things of that description. He knew that one leading manufacturer in the Midlands estimated that if rubber were to fall to 4s. a pound, the present consumption of about 65,000 tons per annum would be doubled, and if it fell to 3s. a pound it would be quadrupled. Those figures indicated that plantation rubber grown at a cost of 1s. a pound had not much to fear from over-production for many years to come.

Mr. H. Figgis deprecated the statement which had been made that if the price of rubber fell to 4s. a lb. a great enlargement of consumption would be likely to take place. He wished he had the manufacturer in the Midlands, to which the last speaker had referred, as his customer, because it w

not 20 years since he sold rubber at considerably less than half its present price. No such enlargement of the industry as had been suggested took place, although he was aware that the circumstances had now changed. The consumption had kept pace with the increase in supply; but the author was candid enough to say that, looking forward to the future, they must as sensible men expect a very large increase from the 250,000 acres in Malaya, India and other regions where plantations had taken place. He therefore thought it would be wise to bear in mind the warning which had been uttered, and not be too sanguine that the present prices would always continue. It would be within the recollection of many that cinchona once sold at 4s. a lb., and it had now come down to a penny and twopence simply because of over-production. He had been very much struck with the admirable quality of the rubber at present being supplied, and did not think it could, as a whole, be easily excelled. Very few parcels of biscuits or sheet had come over at all soft or sticky, and it was a marvellous thing to him that the planters in such a new industry were now able to send to this country such splendid specimens of pure, useful rubber. The author had suggested that planters would like to know how the manufacturers desired the rubber to be prepared, but personally he ventured to think planters would do well to remember that different manufacturers had different wants, and that it was undesirable to prepare the rubber in one uniform way. After a long and wide experience of rubber from all parts of the world, and having sold more rubber as a broker than probably any man living, he desired to say that the planters deserved the utmost praise for the way in which they prepared their product, and the beautiful way in which it was packed and sent to this country; and they were also thankful to Kew and the Colonial Office to a large extent, because it was owing to their efforts that the wonderful success which had been achieved by the industry was due.

Mr. HAMEL SMITH stated that in the West Indies it was found that the cacao estates, after about 25 years, were already beginning to fall off in their yield; but it seemed to him that if, as some people suggested, Castilloa was planted as a shade to cacao that falling away would take place at an even more rapid rate than it was doing where cacao was planted alone. He had been informed by a cacao planter that the output of cacao would also fall away owing to the exhaustion of the soil. It seemed to him that if rubber were planted with cacao, the advantage would be gained on the crop from the rubber tree as a shade tree; but if it tended to deteriorate and hasten the falling off in the crop, he thought the profit would in the long run be diminished rather than increased. He also desired to ask the author's opinion of the use of centrifugal force for separating the latex, as opinion on the subject seemed to be divided. If the latex were produced in such very large quantities as seemed probable, it seemed to him that an accelerated system of separation would have to be employed; and from his knowledge of the use of centrifugal apparatus on sugar estates, he thought that might be a useful method.

Mr. WALTER HANCOCK said that, having devoted sixty years of his life to the manufacture of india-rubber and gutta percha, he had been intensely interested in Mr. Wright's valuable paper, because it gave to manufacturers much information in a small compass. It might be in the recollection of some of the older members of the Society that forty years ago, when the question of india-rubber and gutta percha was under discussion, he (Mr. Hancock) expressed his surprise that, considering the price india-rubber and gutta percha fetched in the market, no one had taken the trouble to cultivate them. He further stated that leaving out of consideration the rare metals, silk and india-rubber were two of the most valuable articles imported into the country; they were articles which grew of themselves, which required little cultivation, and after five or seven years produced a very handsome return upon the outlay devoted to them. He had been particularly struck with the quality of the rubber now imported from Malaya. One of the advantages he held out, when the matter was under discussion forty years ago, was that if the industry were placed in the hands of business men with a manufacturing turn of mind, it would be possible to obtain in this country india-rubber or gutta percha free from the great defects of which the crude article then usually imported was so full. It was then full of chips of the trees and an unfair admixture of adulterations, which sometimes increased weight 10, 15, and 20 per cent., for which the manufacturer had to pay the full price of the pure material. The beautiful uniform quality of the finest rubber recently imported was a matter for much congratulation. A great quantity of African rubber first imported into this country sold at 4d., 5d. and 6d. a pound, but it was ruined in the collection and by exposure to light and heat, so that after a short time it perished in the way in which india rubber did, not by drying, as gutta-percha perished, but by becoming a slimy mass which melted away. Owing to the care which was now taken, more particularly in the manufacture of Malayan rubber, in keeping the latex in a liquid state, not allowing it to be exposed to air, light, or heat, and the way in which it was afterwards manufactured, an almost pure india-rubber was obtained which deservedly fetched a high price, not only because it was clean and pure, but, being free from adulterations, a rubber was obtained which was more likely to be durable, and which did not contain in itself the elements of decay. There appeared to be, he was sorry to say, too much of a rush for promoters to issue the prospectuses of companies for the supply of rubber. Some of the old-standing companies which had a business organisation were

able to carry on the manufacture profitably, sensibly, and advantageously; but in some cases the unfortunate shareholders would ultimately find they had lost all their money. The question of the production of synthetical rubber had been referred to; but for the last 61 years there had been many similar threats made. He had many times tried to manufacture an article that would be equal to india-rubber and gutta-percha, and apparently for a time with success, but with the test of time it vanished. It either became dry and friable and rotted, or it became sticky like birdlime, and was utterly useless. He had very little fear indeed, within his time at any rate, of manufacturers being frightened by the production of a synthetical rubber. Even if it could be made, the question was how far it would be durable. Both india-rubber and gutta-percha possessed most remarkable qualities, two of the most important being their resistance to water and their insulating properties. He was afraid that synthetical rubbers or gutta-perchas would, in the course of time, by drying and decaying or by becoming sticky be utterly useless and unfit to compare with natural india-rubber.

Dr. HENRY STEVENS, in referring to the question of the production of synthetical rubber, stated that although Tilden had prepared a substance resembling rubber from isoprene, his results had been called in question in recent years, and in particular Harries, in Germany, had shown that rubber probably possessed a constitution which made its formation from isoprene improbable. With regard to the question of the quality of plantation rubber, there was an opinion abroad that it did not possess the nerve of the Amazonian Para; but, in his opinion, that could only be satisfactorily settled by vulcanising tests being made with plantation rubbers on exactly the same lines as with wild rubbers. He had himself, in the course of the last few months, carried out vulcanisation experiments with plantation rubbers which had given very gratifying results.

Mr. WRIGHT, in reply, after thanking the members for the manner in which they had eulogised the paper, said that with regard to the series of cautions which had been given to him, he forgot to mention one in connection with the tapping operations as carried out at the present time on a few estates in the tropics. Several planters appeared to be proud of the fact that they were able to manufacture their rubber from shavings, *i.e.*, the bark which was peeled away every day, or whenever the tapping operation was performed, contained a certain amount of latex, which, on drying, could be extracted in the form of rubber. They were evidently anxious to show a very high return from the bark shavings; but it was possible so to tap the trees that the outer bark would dry, and possess not more than 1 per cent. of rubber. To extract 8, 10, and even more per cent. of rubber from bark shavings, as had been stated in some reports recently issued, was, he thought, really more a disgrace that an honour. On some estates, where too rapid tapping had been carried out, very fatal results were observable. He had made experiments in connection with the subject in Ceylon, and he knew in one or two cases that, although the original tappings might give latex possessing 40 to 50 per cent. of water, and up to 50 per cent. of caoutchouc, subsequent tappings of trees which had been too frequently irritated, gave a latex in abundance, but one which contained 90 per cent. of water, and only 10 per cent. of caoutchouc. That was a most important matter which ought to be brought before the planters. He did not believe at the present time, owing to the precautions which were being taken, that there was the slightest danger of any disease for a few years to come. Mr. Hamel Smith referred to the question of cacao and rubber. Personally, he was not very much in favour of castilloa and cacao, and the only reports issued by the botanic department of St. Lucia and Dominica showed that much better results had been obtained when *Hevea brasiliensis* had been used in conjunction with cocoa instead of Castilloa. He strongly recommended *Hevea brasiliensis*. Mr. Smith also mentioned that the cacao would sooner or later go. Cacoa was a rather peculiar plant, the root system of the tree being quite unlike that of most other plants cultivated. It was not as compact as the root system of tea, coffee, or the cocoanut palm. The roots were widely separated and allowed of the penetration of the roots of other plants, and the two products—rubber and cacao—could grow for a considerable length of time. He had in mind one cacao and rubber plantation which was, he believed, 20 years old; the *Hevea brasiliensis* varied from 7 to 11 years old, and both products were doing excellently to-day. Mr. Smith also raised a question on the subject separating the latex by centrifugal means. Weber, Biffin, and a few others had reported succeesful experiments in connection with the latex of Castilloa, stating that when the latex of that species was subjected to centrifugal force in an ordinary creaming machine it was possible, owing to the large size of the caoutchouc globules, to seperate them. He (Mr. Wright) thought he could do the same with Hevea; but on placing the ordinary latex of *Hevea brasiliensis* in a centrifugal machine, which was made to revolve at the rate of 11,000 feet per minute, there was no separation effected. The caoutchouc globules in *Hevea brasiliensis* were very small, and even if the density of the mother liquor was increased by the addition of solutions of sodium sulphate, it still seemed impossible to separate the globules of Hevea by mechanical means.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Wright for his instructive and interesting paper, and the meeting terminated.

THE MEAT SUPPLY OF PARIS.

Prior to 1810 the butchers of Paris slaughtered animals in the streets and public squares, but at that time municipal slaughter-houses—abattoirs—were established, where animals intended for human food are inspected, and the whole process of slaughtering and disposal of the meat and offal are kept under official surveillance. There are in Paris three principal abattoirs, the largest of which, "La Vilette," is in the northern quarter of the city; "Vaugirard," which was opened in 1898, and replaced the old slaughter-house of Grenelle; and "Villejuif," where horses are killed for food. Any butcher may slaughter animals at these abattoirs on payment of a tax of one shilling and eightpence per 220 pounds on the meat so prepared. Butchers of the more important class, and specially licensed, are permitted to sell the meat which they have thus provided directly to the smaller dealers who keep retail meat stores throughout the city. Inspectors are in constant attendance and any meat found infected with disease, or otherwise unfit for food, is saturated with petroleum and condemned. Living animals which are found to be contaminated are required to be sold for a nominal price to the "Knacker," and this regulation is so effective that of the 250,000 head of cattle slaughtered annually in Paris, an average of 30 only per month are condemned. The abattoirs are open to the public from 10 a.m. to 7 p.m., and the American Consul-General in Paris says that invalids are frequently sent there to drink the warm blood of the oxen, which is thought by some to have a curative effect. The slaughter-house of "La Vilette" is situated in the Rue de Flandres, in the extreme north-eastern district of the city, and is divided by the canal St. Martin from a large and well managed public market or stockyard, where cattle, sheep and swine are sold. The abattoir itself includes space for 2,950 cattle, 9,700 sheep, and 1,500 calves. The principal killing days are Tuesdays and Fridays, which precede the principal market days of Paris. The record shows that the average daily work during the autumn and winter months is to slaughter and prepare for market 1,200 cattle, 800 sheep, and 500 calves. The record of an average year is 250,000 cattle, 205,000 calves, 1,676,000 sheep and goats, was 126,000 tons of beef, veal and mutton, and and 230,000 hogs, and the product of the last year 16,000 tons of pork. The hides are sold at a special market, the Halles des Cuirs, which was lately destroyed by fire, and is to be rebuilt, and a considerable percentage of them is bought for export. "Vaugirard," the second in importance of Paris abattoirs, employs 50 butchers, and during an average year slaughters 30,000 head of cattle, 36,000 calves, and 200,000 sheep, which yielded 15,112 tons of meat. The third, and smallest, of the abattoirs, "Villejuif" provides meat for the board of public charities, and slaughtered during an average year 15,000 oxen, 9,000 calves, and 65,000 sheep. Both "Vaugirard" and "Villejuif" have departments for slaughtering horses, donkeys and mules and the total nnmber of such animals disposed during a recent year, was 18,000 horses, 250 donkeys, and 50 mules, which yielded 4,417 tons of meat. Butchers and meat dealers who sell horsemeat are required to have a special sign, a horse's head, over their places of business, and it may not be sold at a store not thus designated. The last year for which complete statistics concerning the meat supply of Paris have been published in 1903. From the reports of that year it appears that 267,027 cattle, 274,390 calves, and 2,047,770 sheep were slaughtered at the city abattoirs, and produced 327,616,000 pounds of meat, of which 259,796,000 pounds were consumed in Paris, and 71,044,000 pounds exported. Some of the choicest of French beef comes to England where the fillets and other prime cuts are in demand for clubs, hotels and the better-class restaurants. During the same year there were killed 282,508 pigs, which yielded 58,080,000 pounds of pork, and 29,370 horses, which furnished, 15,342,000 pounds of meat, all of which was consumed in Paris. A striking feature of all these statistics is the very large percentage of calves slaughtered, and veal consumed in Paris, in proportion to other meats. This is mainly a result of the careful thrift of the French peasant, who makes a point of generally having on his premises one or more calves, which are fed on skimmed milk combined with other food materials produced at home, so that the selling price of the fatted calf is, to a large extent, clear profit. The carefully enforced inspection system, which subjects every animal intended for slaughter to examination, prevents the killing of immature calves, and the veal of Paris and other French cities is uniformly of excellent quality. The average meat yield of oxen killed in Paris in 1903 was 697 pounds, sold wholesale to dealers at the "halles centrales" for an average price of sixpence per pound. Calves yielded 155 pounds per head, of veal, which was sold for about eightpence per pound. Sheep yielded an average of 46 pounds of mutton, which sold for between eightpence and ninepence per pound. Pigs, 172 pounds each of pork, the wholesale price of which was about sixpence per pound. As a rule the butcher's meat slaughtered and sold in France is nearly all of home production. The native races of cattle, namely the "Limousin" from the central departments, the "Normandy" from the north-west, and the "Nivernais" from the department of Nièvre, are unsurpassed as producers of beef of the highest quality. The whole imported stock for slaughtering purposes during 1904 was only 14,409 head, of which 11,030 came from Algeria, 2,869 from Italy, and 510 from all other countries. With sheep the case is quite different, Land and grass are too valuable, except in certain limited districts, to be given over to sheep grazing, so that the mutton supply is largely of foreign origin. The record of 1904 shows that there were imported 1,169,635 head of sheep, of which 1,078,225 came from Algeria, 30,000 from Tunis, 16,327 from Montenegro, 3,255 from Spain, 2,200 from England, and 19,300 from Russia. The pork supply is almost exclusively home grown, only 3,000 pigs having been imported into the whole of France

during the year, whereas 73,000 live pigs were exported to Switzerland. The intelligent, careful thrift of the French farmer, the rational system of inspection of animals and meat before, and after slaughtering, the cleanliness and orderly management enforced at the abattoirs and the "halles" where the meats are sold, combine to render the meat supply of Paris regular, abundant, and equal perhaps in quality to that of any city in the world.

THE UTILISATION OF EXHIBITIONS IN GERMANY.

A movement has been started in Germany for utilising national and international exhibitions in the promotion of foreign trade, and a permanent commission for exhibitions, which has just been established in that country, will occupy itself with matters pertaining to all large exhibitions, whether they be held in Germany or in foreign countries. It will be the purpose of the new organisation to obtain exact data as to the aims, extent, and possibilities of each exhibition planned. Fully informed, it will be in a position to give precise practical directions to inquirers, with the object of promoting German manufactures and trade. It has happened in the past that an exhibition has been projected abroad with some well-sounding name, and under plausible auspices, which has been largely speculative, of very limited compass, where medals and highest awards are supposed to have been granted for a pecuniary consideration. To protect exhibitors, however, against such eventualities will be one of the objects of the commission. The American Consul at Planen says that this organisation, primarily a patriotic one, will also endeavour to act as intermediary between the management of the various exhibitions and German exhibitors, so that the latter will not individually have to correspond, in more or less uncertainty, with the promoters of the exhibition. Greater solidarity will result in the representation of national interests, and where these are sparsely shown, or lacking, the results of a protective supervision are reckoned upon to call attention to an opportunity likely to be neglected. The commission has the support of the great manufacturing and commercial interests of the country, and will be in touch with the Government. Although many of the German exhibitions are only of local importance, it is not unlikely that certain British interests could be advantageously represented and developed. For instance, the agricultural fairs, such as those held annually at Düsseldorf, can be utilised for the display of farming machinery. In machinery and industrial exhibitions, which are held from time to time, there is a wide range for remunerative business. An exhibition for out-of-door sports affords a good opportunity for showing portable houses, tents, camping outfits, fishing-tackle, guns, &c. In the poultry shows, incubators, and various patent poultry-house appliances, have an excellent chance.

HOME INDUSTRIES.

Insurance Companies and Earthquakes.—The insurance world has taken to heart the lessons of the San Francisco earthquake, and is insisting upon conditions of insurance which will make a repetition of the San Francisco losses impossible. Policies will have clear and specific conditions exempting from liability for fires resulting from earthquakes. In San Francisco it was not so. All excepting two or three companies doing business there relied upon a condition which exempted them from liability for fires in fallen or partly fallen buildings. The common idea was that the first effect of an earthquake would be the fall of the buildings. That proved not to be necessarily the case. It is now better realised that electric light and telephone wires, gas pipes, and all the many applications of artificial light and heat to trade purposes—under the streets, overhead, and inside buildings—make the risk of fires resulting from earthquakes greater than was ever anticipated, while the almost certain simultaneous destruction of the water supply takes away the means of extinguishing them Insurance companies have, therefore, to protect themselves against these risks, and it is becoming evident that the only safety will be in the adoption of a condition which will make their non-liability absolutely indisputable. There is, of course, the other question of insurance companies giving insurance policies against fires resulting from earthquakes. Where that is done there will have to be a very substantial extra premium to cover the risk in San Francisco and other parts of the world where earthquakes are frequent, or comparatively so.

Home Railways and Stocks. — Attention has more than once been directed in these notes to the low price of home railway stocks. Since this was pointed out there has been some little improvement, and it is reasonable to assume that it will go further. For the depreciation in recent years has been very heavy, excessively so, as many think, having regard to merits. However that may be, the fall itself is indisputable, and is strikingly illustrated by tables compiled by the *Economist*. These tables give the current quotations of the ordinary stocks of all the principal railways, the dividends for the whole year 1906, and the yields based upon them. The years taken for comparison are 1897, 1902, and now. The fall in value is particularly noticeable in the case of preferred ordinary stocks bearing a fixed rate of dividend. The Great Northern 4 per cent. dropped from $122\frac{1}{2}$ in 1897, giving a yield of $3\frac{1}{4}$ per cent., to 99 in 1902, and 99 at the present time, at which last figure the yield is $4\frac{1}{16}$. The 6 per cent. stock of the same company was quoted $195\frac{1}{2}$, giving a yield of $3\frac{1}{16}$ in 1897, to $152\frac{1}{2}$ in 1902, and $149\frac{1}{2}$ now, the last price giving a yield of 4 per cent. South-Western 4 per cent. was at 134 in 1897, and is now 102, giving a respective yield of 3 and $3\frac{15}{16}$. Brighton 6 per cent. was at 200 ten years ago, and to-day is

quoted at 141, the respective yields being 3 and 4¼. The contrast is even more remarkable with regard to the ordinary and deferred stocks. The dividends distributed in 1906 were all at higher rates than those for 1901, yet prices are substantially lower at the present time. Take the premier stock, that of the London and North-Western. Last year's dividend was 6⅜ per cent. against 5½ per cent. for 1901, but the price is only 149½ against 162 in 1902, the yield being 3⅜ five years ago as against 4½ now. In 1902 the highest yield was $4\frac{1}{16}$ per cent. on London Tilbury stock and $4\frac{1}{8}$ per cent. on Great Northern Preferred. Now the highest yields are 5⅜ per cent. on North London stock and 5 per cent. on Brighton Deferredr Out of twenty-four stocks eighteen now give a return of 4 per cent. and upwards; five years ago only two stocks yielded as much as 4 per cent., and five gave a return under 3 per cent. It would seem from these figures, and others that might be submitted, that at present quotations first-class railway stocks are exceptionally cheap, for there is nothing in the general outline of an unusually disturbing character.

The Port of London.—At the time of the introduction of the London Docks Bill the hope was expressed that it might be possible to arrive at some general agreement which would enable the Government to support it, and so pave the way for the changes and improvements which are indispensable, and must be brought about without much further delay, if London is to retain its position as the greatest port in the world, a position it has held for the last 200 years. That hope has not been realised, but an exhaustive review of the position, contributed by a correspondent of *The Times*, demonstrates the pressing character of the problem to be solved. It is pointed out that the docks are now working at their maximum capacity, and there is no room anywhere for another line of large steamers. The Port of London has maintained its position not as the result of improvements in the river, or in the facilities afforded by the docks, but because the port is the centre of a large population with all its natural needs, and the financial and trading centre of the Empire. Moreover, London has many natural advantages. It is well situated for trade with all parts, its shipping is well sheltered, it has a good tidal river, and a good natural scour, and there is no bar. But the port is in danger of losing some of its trade, largely owing to the enormous increase in size of ocean going vessels. A great advantage of foreign competing ports is that with them public ownership and control are universal, Copenhagen and Marseilles alone excepted. The ports are controlled by national or local public authorities. In Germany, Bremen and Hamburg, they are administered by the States. At Rotterdam and Antwerp they are governed by the municipalities, while at Havre, as at all other French ports, the docks and quays are controlled and financed by a Central State Department with the assistance of the local Chambers of Commerce, and they are served by Government officials and workmen. With us for the last sixty years the river has been under the control of the Thames Conservancy, which two years ago obtained a Bill by which they were to provide a channel 1,000 feet wide, and 30 feet deep at low water from the Nore to Gravesend, a length of about 21 miles. Some progress has already been made with this scheme. But the depth of 30 feet is inadequate if it is hoped to draw to the Thames the largest vessels either mercantile or naval. Figures quoted by the correspondent referred to above demonstrate this. Seaward to the Nore there has always been sufficient depth, but the existing depth between the Nore and Gravesend is only about 25 feet to 26 feet, and in some places it is only 24 feet. Between Gravesend and the Royal Albert Docks, it varies from 24 feet to 16 feet and were in places only 15 feet. From the Royal Albert Docks to Millwall it is between 14 feet and 18 feet with patches only 12 feet. Between Millwall and the Thames Tunnel, there is a channel 300 feet wide and 16 feet to 13 feet deep. Over the Thames Tunnel the depth is only 13 feet, and between the Tunnel and London-bridge 14 feet at low water. Since 1902 there have been no dock extensions in London, it being impossible for the dock companies to raise the necessary capital until the Government intentions are disclosed. There is no dock either wet or dry on the river that can take anything approaching the largest liners or battle ships. What is wanted is this summarised by the correspondent already quoted. It conforms roughly to the recommendations of the Royal Commission—(1) A 35 feet channel up to Gravesend, a 30 feet channel from Gravesend up to the old London and India Docks at least, and the full width of the river wherever possible; (2) New wet docks, with a maximum width of entrance of 100 feet, a maximum depth of 40 feet, and capable of affording berthage to at least eight of the largest liners, with all necessary quay space, sheds, &c.; (3) Three dry docks, with maximum width of entrance 100 feet, a minimum depth over sill at low water of 40 feet, and 700 feet to 1,000 feet in length, all fully equipped; (4) The existing docks brought up to date, with plenty of quayage, and shed accommodation, and every appliancefor dealing with cargoes with the greatest possible despatch. This, of course, would mean a very large capital outlay, but something like it is indispensable if the Port of London is to hold her own against her Continental rivals.

The Cotton Industry. — The outlook for this industry continues favourable, except in one quarter. Relations between employers and employed are becoming strained. The cotton weaving employers of Lancashire have refused the application of the operatives for a rise in wages to the extent of 5 per cent. on the ground that the large majority of the manufacturing firms use bought yarn, and that this trade is in a very poor condition owing

chiefly to the high prices ruling for twist and weft. It remains to be seen what the operatives' officials will advise. The report is that they will be in favour of allowing the question to remain in abeyance, and that in the meantime the condition of the weaving trade be closely watched with a view to taking any further action later on that may be deemed advisable. Another statement is to the effect that the operatives will now consider the question of giving notice to cease work on a given date. About 120,000 operatives are affected, and a 5 per cent. advance would mean an addition of from 1s. to 1s. 6d. to the weekly wages of individual weavers, so that the rise would cost the employers from £6,000 to £7,000 per week. The fine counts wages question has been referred by the Oldham Employers' Association to the Central Federation in Manchester, so that the matter may be dealt with by the trade, as a whole. The operative spinners are asking for a general advance of 5 per cent. on the old standard list. The proposed conciliation scheme for adjusting wages according to the state of trade is not likely to be put into operation this summer. It may be hoped that the present flourishing state of the cotton industry will not be jeopardised by the refusal, whether of employers or workmen, to consent to compromise representing an equitable adjustment of opposing interests.

The Imperial Maritime Conference.—There will be no difference of opinion as to the desirability of an Imperial Maritime Conference to reconcile differences caused by Colonial legislation. Such a Conference has been sitting for some time past. At present the law is in a very anomalous and unsatisfactory condition. British vessels sailing from the United States in full accord with British shipping laws find themselves, on reaching Australia, under another and contradictory set of laws, and if such vessels go on to New Zealand they come under yet another set of laws altogether. That uniformity of maritime legislation throughout the Empire is wanted is more obvious than how it is to be brought about, for Colonial statesmen are by no means in accord with British views on the subject. The home view is that if a shipowner sends his ship to any British possession he should know that his property is placed under no other obligations than those to which it has to submit in Home waters. But that is not the view of Australia and New Zealand. One resolution actually passed lays it down "That no person should be employed as an officer on board any British ship registered in Australia, or New Zealand, or England, in the coasting trade of these colonies who is not (*a*) a British subject, and (*b*) thoroughly conversant with the English language." That is a very wide reaching suggestion. Under it a New England skipper could not command a vessel trading in those waters because he is not a British subject, and, say, a French-Canadian, though a British subject, might not be allowed to command because he could not speak English. Some surprise has been expressed at Canada not being represented at the Conference. There may be good reasons but they are not easy to discover. Canada is interested in the maritime legislation of the Australasian Colonies, and before long her interest will be a much larger one. It is true that hitherto no difficulty has been caused by any shipping legislation of the Dominion.

GENERAL NOTES.

THE UNITED KINGDOM AND CANADIAN TRADE.—It is noticeable that the percentage of imports from Great Britain in 1906 increased, as compared with 1905, from 23·98 to 24·42, whereas the percentage from the United States receded from 60·58 to 59·59. In the case of Great Britain, the percentage on dutiable goods increased from 29·88 to 30·40, receding in free imports from 15·14 to 15·03; the decline in American free imports being from 73·13 to 71·90, and in dutiable from 52·21 to 51·74. But if the total imports from the two countries are taken, it will be found that whereas the figures for Great Britain show a rise from 60,342,704 dols. to 69,183,915 dols., only those for the United States increased from 152,431,626 dols. to 168,798,376 dols.; or nearly double those of the United Kingdom. On the other hand, the percentage of exports to Great Britain rose from 50·61 to 53·96, as against a fall in the exports to the United States from 37·51 to 35·68. And so absolutely whilst the exports to Great Britain rose from 101,958,771 dols. to 133,092,571 dols., those to the United States only increased from 75,563,015 dols. to 88,001,309 dols. Canada's trade with the West Indies was slightly less than in 1905, when there was unprecedented expansion, but it may be noted that imports from Newfoundland increased from 1,059,417 dols., exports thereto showing a slight falling off from 3,473,713 dols. to 3,213,856 dols.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MAY 1.—"The Defence of the Sea Coast from Erosion." By ALFRED EDWARD CAREY, M.Inst. C.E.

MAY 8.—"The Production of Coke and its Application in Domestic Fires." By PAUL SCHLICHT. CORBET WOODALL will preside.

MAY 15.—"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 2.—"The Applicability to India of Italian Methods of Utilizing Silt." By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D., late Secretary to the Government of India, Revenue and Agricul-

tural Department. SIR CHARLES A. ELLIOTT, K.C.S.I., LL.D., will preside.

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department. CHARLES EDWARD HENRY HOBHOUSE, M.P., Under Secretary of State for India, will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock :—

APRIL 30.—"Lustre Pottery." By WILLIAM BURTON. J. C. WEDGWOOD, M.P., will preside.

∴ A collection of examples of lustre pottery from the Victoria and Albert Museum, and from private owners, will be arranged to illustrate Mr. Burton's paper, and will be on view during the afternoon and evening of the day of the meeting.

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

PROF. HERBERT JACKSON, F.I.C., F.C.S., "Detergents and Bleaching Agents used in Laundry Work." Three Lectures.

LECTURE III.—APRIL 29.—The problem of washing—Textile fabrics: easy methods of distinguishing between them chemically and by the microscope—Shrinkage of woollen goods—Behaviour of various fabrics with detergents and bleaching agents—Influence of acids, alkalies, &c., on the individual fibres—Precautions to be observed.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, APRIL 29...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Cantor Lecture.) Prof. Herbert Jackson, "Detergents and Bleaching Agents used in Laundry Work." (Lecture III.)

Farmers' Club, Whitehall Rooms, Hotel Metropole, S.W., 4 p.m. Mr. G. F. Slades, "What is required in a New Valuation Bill with regard to Methods of Assessment and Collection."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Dr. Fridtjof Nansen, "Polar Problems."

Actuaries, Staples-inn-hall, Holborn, E.C., 5 p.m.

TUESDAY, APRIL 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. William Burton, "Lustre Pottery."

Asiatic, 22, Albemarle-street, W., 4½ p.m. Major P. R. Gurdon, "The Khasis and the Austric Theory."

"Hellenic Studies," in the Rooms of the Society of Antiquaries, Burlington House, W., 5 p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. Stirling, "Stimulation, Luminous and Chemical." (Lecture II.)

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Annual Meeting.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. H. O. Klein, "With a Hand Camera to the Niagara Falls."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W. 3 p.m. Mr. H. M. Veitch, "The Amateur and Horticultural Law."

WEDNESDAY, MAY 1...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. Alfred Edward Carey, "The Defence of the Sea Coast from Erosion."

Geological, Burlington-house, W., 8 p.m.

African, Criterion Restaurant, Piccadilly, W., 8 p.m.

Royal Archæological Institution, 20, Hanover-square, W., 4½ p.m.

British Archæological Association, 32, Sackville-street, W., 4½ p.m. Annual Meeting.

Obstetrical, 20, Hanover-square, W., 8 p.m.

Royal Institution, Albemarle-street, W. Annual Meeting.

THURSDAY, MAY 2...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Sir Edward Charles Buck, "The Applicability to India of Italian Methods of Utilizing Silt."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Prof. E. B. Poulton, "The Fauna and Elora of Abyssinia Compared with those of West Africa." 2. Mr. Cyril Crossland, "Report on the Marine Biology of the Sudanese Red Sea" (communicated with an Introduction by the President). 3. "Formation of the Shone Cliff near Alexandria." 4. "Recent History of the Coral Reefs of the North-West Shores of the Red Sea." 5. Mr. E. R. Sykes, "Polyplacophora Collected by Mr. Cyril Crossland." 6. Mr. C. J. With, "Chelonethi (Pseudoscorpions) from Asia and Australia." 7. Mr A. B. Darbiseire, "Note on the Function of the Spiracle in certain Elasmobranchs." Exhibition:—1. Prof. E. B. Bulton, "Probate of the Will of Richard Anthony Salisbury" and "Manuscripts of Dr. W. J. Burchell."

Chemical, Burlington-house, W., 8½ p.m. 1. Sir W. Ramsay, "The Chemical Action of Exradio." Part I. "Action on Distilled Water." Part II. "Action on Copper Salts in Solution." Preliminary note. 2. Messrs. A. Findlay and E. M. Hickmans, "Freezing-point Curves of the Menthyl Mandelates." 3. Messrs. F. B. Power and F. Tutin, "The Constitution of Homoeriodictyol. A Crystalline Substance from Eriodictyon Leaves." 4. Mr. G. Le Bas, "The Relation between Valency and Heats of Combustion." Preliminary note.

Royal Institution, Albemarle-street, W., 3 p.m. Dr. A. W. Verrall, "The Bacchantes of Euripides."

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Mr. C. Wade, "The Use of Wooden Poles for Overhead Power Transmission."

FRIDAY, MAY 3...Royal Institution, Albemarle-street, W., 9 p.m. Sir James Crichton Browne, "Dexterity and the Bend Sinister."

North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7½ p.m. Mr. J. L. Twaddell, "Sectional Work in Ship Construction."

Geologists' Association, University College, W.C., 8 p.m. 1. Professor S. H. Reynolds, "The Igneous Rocks of the Bristol District." 2. Mr. T. F. Sibly, "The Carboniferous Limestone Sections of Burrington Combe and Cheddar." 3. Mr. A. Vaughan, "Recent Researches in the Lower Carboniferous Rocks."

Philological, University College, W.C., 8 p.m. Annual Meeting.

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

SATURDAY, MAY 4...Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. C. McIntosh, "Scientific Work in the Sea Fisheries." (Lecture I.)

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FRIDAY, MAY 3, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, MAY 8, 8 p.m. (Ordinary Meeting.) PAUL SCHLICHT, "The Production of Coke and its application to Domestic Fires."

Further details of the Society's meetings will be found at the end of this number.

CANTOR LECTURES.

PROF. HERBERT JACKSON, F.I.C., F.C.S., delivered the third and last lecture of his course on "Detergents and Bleaching Agents used in Laundry Work," on Monday evening, 29th April.

The CHAIRMAN (Prof. J. M. Thomson, LL.D., F.R.S.) moved a hearty vote of thanks to the lecturer for his valuable and interesting course.

The lectures will be published in the *Journal* during the summer recess.

APPLIED ART SECTION.

TUESDAY, APRIL 30th, 8 p.m.; J. C. WEDGWOOD, M.P., in the chair. The paper read was "Lustre Ware," by WILLIAM BURTON, F.C.S.

The paper and report of the discussion will be published in a future number of the *Journal.*

⁎ A select collection of fine examples of ancient and modern lustre ware were exhibited in illustration of the subject of the paper.

Specimens were lent by the Board of Education (from the Victoria and Albert Museum), Mr. Lewis F. Day, Messrs. Thomas Goode and Co., Messrs. Liberty and Co., Messrs. Morris and Co., and Mr. W. Burton (from his own collection). The following manufacturers also lent examples of the productions of their kilns: — Messrs. Carter and Co., Messrs. Craven, Dunnell and Co., Messrs. Maw and Co., Bernard Moore, Pilkington's Tile and Pottery Co., and Mr. A. Wenger.

INDIAN SECTION.

THURSDAY AFTERNOON, MAY 2, 4.30 p.m.; SIR CHARLES A. ELLIOTT, K.C.S.I., LL.D., in the chair. The paper read was, "The Applicability to India of Italian Methods of Utilizing Silt," by SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D.

The paper and report of the discussion will be published in a future number of the *Journal.*

PROCEEDINGS OF THE SOCIETY.

NINETEENTH ORDINARY MEETING.

Wednesday, May 1, 1907; MAJOR MONCREIFF PAUL, R.E., in the chair.

The following candidates were proposed for election as members of the Society:—

Coelho, Sertorio, M.A., Rua do Conselheiro No. 7, Nova Goa, Portuguese India.
Ford, James Francis, 17, Pembridge-square, W.
Gossain, Hem Chandra, Tezpur, Assam, India.
May, Theodore Martin, Assoc.Am.Soc.C.E., Rooms 1745-1749, 42, Broadway, New York City, U.S.A.

The following candidates were balloted for and duly elected members of the Society:—

Foucar, Alexandre Ferdinand Emile, Beaulieu, St. John's-park, Blackheath.

Felberman, Louis, Bladen-lodge, Bolton-gardens South, S.W.

Shaw, Mrs. G. Bernard, 10, Adelphi-terrace, W.C.

The paper read was—

THE PROTECTION OF SEA SHORES FROM EROSION.

By Alfred Edward Carey, M.Inst.C.E.

(Fellow of the Royal Geographical, Geological, and Chemical Societies).

I have been asked to speak to you this evening on the question of the Protection of Sea Shores from Erosion. This subject is one which may be regarded from a great many different standpoints, and it is moreover of considerable complexity. I cannot hope in an hour's paper to do more than allude to a few of the more salient features of the question, and my endeavour will be to lay before you practical rather than theoretical issues. Can the forces at work on a storm-beaten foreshore be controlled? If so, what are the readiest and most effective weapons for securing this object? What legislative changes are necessary in order to secure this result? In a satisfactory answer to these questions lies the solution of the problem. When Queen Elizabeth was "crediblie enformed that the Queene's Majestie's towne of Dunwytche . . . . . was by rage and surgies of the sea, daylie wasted and devoured; and the haven of her highnes said towne by diverse rages of wyndes continually landed and barred, so as no shippes or boates could either enter in or oughte, to the utter decay of the said towne," her remedy was simple. She ordered the bells, lead, iron, glass, and stone of Ingate Church, and the lead from the chancel of Kessingland Church to be sold and the proceeds lent to the town of Dunwich.

The same havoc is going on now on large areas, more especially of the Eastern coast of England, as in Queen Elizabeth's day, and ways and means for combatting the evil are still a vital question of the hour.

So far as the legal aspect of the matter is concerned, there seems to be no shadow of doubt that the obligation of defending the coast-line of the United Kingdom rests upon the King's Government. Coke's dictum is—"The King ought of right to save and defend his realm, as well against the sea as against his enemies, that it should not be drowned or wasted."

A long series of Judges of the greatest eminence, whose decisions reach down to the present day, have held precisely the same view, and judicial opinion going back to the reign of King Henry VI. supports the same contention. The difficulty is that if the Crown—or rather the Public Department concerned—does not move in the matter, how is it to be compelled to do so? There is practically no remedy, the only expedient the *Subject* has being to proceed by petition of right.

Broadly speaking, the Woods and Forests Department have control between high and low water levels, and below low water mark the rights of the Board of Trade come in; but on a coast-line, the boundary of which is continually shifting, how can these lines be satisfactorily defined? Endless disputes have arisen in settling points arising from this issue.

Then, again, lords of the manor and others have, either by Royal grant or immemorial usage, acquired in many localities the right of the removal of shingle and sand. This power is frequently exercised in such a way as to menace the safety of a contiguous sea frontage. Each town or district council abutting on the sea coast has its own strip of foreshore to defend, and the works which it carries out, in all probability, by arresting the travel of the shingle and sand, are detrimental to the districts to leeward of the one they control.

The first thought of the authorities in every district naturally is to safeguard the stability of the foreshore of that district; thus interminable complications arise, and almost every frontager or municipality is openly or covertly at war with the interests of his neighbour, who depends for the existence of his foreshore upon the regular travel of that circulating medium of defence provided by nature.

Added to these considerations is the fact that every longshoreman considers himself an expert in coast defence. Every boatman considers himself aggrieved by the carrying out of works which interfere with the foreshore, and may thus add difficulty or danger to the exercise of his calling. Small town and district councils can seldom be induced to look ahead and provide the means of defence against the inevitable forces of attack. When they do so they are often denounced by the indignant ratepayer for extravagance. I heard a case the other day of a local Board which had spent money in building groynes, "and now," said a sapient

ratepayer, "look at them, Sir, they are covered with sand and shingle and completely buried, and our money is wasted."

The first matter of primary importance to consider in devising works of coast protection is the profile of conservancy of the sea bottom contiguous to the foreshore. If at low water are found wide stretches of sand with a gradient of one in thirty, or flatter than this, it may be assumed that the problem to be attacked is a much less severe one than if the engineer has to deal with a cliff-bound coast, having little sea marge, or with a coast-line carrying large shingle at a steep angle.

The scouring power of the waves on the east coast of Scotland, will be found utterly different to the corresponding forces on the opposite Dutch coast.

A study of the type of boats which frequent a coast, furnishes a good idea of the sort of seas to expect. The Dutch fishermen, with their shallow flat-bottomed boats, have to deal with a surfy sea, but a sea that would be powerless to move those huge boulders, often up to two tons in weight, which the Scotch fishermen are not unaccustomed to see cast up from deep water, and which they term "travellers." When these boulders are overgrown with masses of seaweed, their buoyancy is greatly increased.

Many incidents may be cited of the almost incredible effects of storm action on a coast-line of extreme exposure. At the harbour works at Peterhead, concrete apron blocks weighing 47 tons each, and placed in position at a depth of about 40 feet below low water, were rooted out of their bed in the work and drawn seawards for a considerable distance.

On the Bound Skerry, an island in the Shetland group, a single mass of rock weighing 5½ tons, at a level of 72 feet above extreme high water, was not only moved but actually quarried from its position by the force of water shot into the air from the base of the cliff; and another adjoining mass of 13½ tons was displaced and tilted.

The effect of these gales is also far-reaching in the movement of sand, as it has been demonstrated, off the Devonshire coast, that lobster pots at a depth of 30 fathoms (or 180 feet) have been filled with sand.

Another extreme example of wave force is illustrated by the slide thrown on the screen.

At Dover Harbour tiers of concrete blocks weighing 40 tons each, and stacked three deep one above the other, were shifted bodily by the force of the waves in the manner shown in the photograph, and were only prevented from moving across the breakwater and falling over its lee side by the line of tramway. This, as will be seen, was twisted out of line and shape by the creeping movement of the blocks.

FIG. 1.

SHIFTING OF CONCRETE BLOCKS ON SOUTH BREAKWATER, DOVER HARBOUR.

Against forces of such magnitude it might seem hopeless to contend. It has, however, fallen to my lot to have to construct in various localities, at home and abroad, breakwater works. To watch a work of this description, creeping seawards week by week, and "beating the storms to laughter," is ample compensation for the many anxieties with which a harbour engineer has to contend in the execution of his duty.

The lantern slide now to be presented shows the root of the breakwater at La Guaira, Venezuela, a port on the north coast of South America, and lying immediately on the edge of the hurricane track. I had charge of the construction of these works, and the conditions subsisting at this spot are of almost incredible violence. The seas are oceanic in type, and about 120 miles to the north of the port the ocean depth is the second greatest of any portion of the globe. The effect caught in the photograph shown on the slide is one of great interest, as it will be seen how the recoil of a sea, striking a solid obstruction such as this, is met by the oncoming wave, and the result is a cascade of water at a considerable distance away from the structure, the forces of attack and recoil being mutually destructive. (Fig. 2.) This work was eventually carried into a depth of 47 feet of water, at a cost of a million sterling.

The lantern slides now to be shown will illustrate better than a long description the action of seas in deep water as they attack solid piers or similar constructions. For the use of these slides I am indebted to the firm of Messrs. S. Pearson and Son, by whom the

FIG. 2.

RECOIL OF WAVES FROM BREAKWATER AT LA GUAIRA, VENEZUELA.

National Harbour Works at Dover are being carried out. They are taken on the Westward, or windward, side of the Admiralty Pier. To use the sailors' phrase, the rollers are just beginning "to smell the ground." (Fig. 3.)

Going back again to the more immediate subject of the evening, it is a matter of prime importance to note the geological nature of the coast-line.* Measures which would be successful if dealing with a chalk cliff or cliff of primary rock, would be disastrously inadequate if applied when the cliffs are of tertiary clay, or "platimore," or "blue slipper," as it is locally termed in the Thames estuary, or if applied at the foot of a sea slope of glacial drift.

Another good indication of what may be expected is the vegetation both of the line of cliffs and of the bed of the sea. If the laminaria and other long-growth seaweeds are present in profusion and perfection in close proximity to a coast-line, otherwise of severe exposure, it will indicate that this portion of the sea bed is protected from the lash of the sea, either by projecting reefs, or by some set of tidal current. In the same way, if a cliff line is clothed with marine vegetation down to the limit of the foreshore, that fact will generally be an indication of an absence of extreme disturbing conditions.

It does not do to depend too implicitly on this latter class of information. The ordinary level of surf marks and vegetation may be completely swamped by tides of abnormal height, and plants like the sea eryngo and the horned poppy on these occasions are submerged without injury. I have recently had to advise a corporation on the East coast on the sea protection of the town, and found that on January 7th, 1905, the tide rose actually 6 feet 3 inches, above normal high-water mark.

The level at which the lepas, or barnacle, is found, may thus be a misleading guide as to the extreme range of the tides. In localities like the Channel Islands and the North of Scotland, boulders will be found projected by the sea far above high-water level.

In this class of observations you will thus see that the greatest caution is necessary.

At a recent meeting of the British Association, a paper was read by Mr. Clement Reid, F.R.S., in which he dealt with considerable novelty with the question of coast erosion from the side of archæological research and of recent geological change. He sought to establish the proposition that, at the period of Neolithic man,

FIG. 3.

ACTION OF SEAS ON SOLID PIERS, ADMIRALTY PIER, DOVER.

the sea level around Great Britain was about 60 feet lower than it is at present. His statement was:—"I can only say that a close study of the buried land-surfaces found in the alluvium at various depths down to about 50 feet

* I am indebted to the Council of the Geological Society for the map exhibited.

below the sea level, shows that oak trees flourished on the lowest of these ancient soils. This proves that the sea then stood so far below its present level that no sea water could reach the roots of these trees."

Following up this argument he inferred that, at the Neolithic period, our coast frontage included a belt of low ground extending out approximately to what is now the 10-fathom line. He expressed the opinion that about 4,000 years ago a fairly rapid and intermittent subsidence of the land or rise of the sea took place round our shores. It is conceivable that a greater or less percentage of the world's capital of water might be, at various periods, locked up in the form of snow and ice at the poles, but, except on this hypothesis, I confess I cannot see any basis of physical possibility for the supposition that a rise in sea level could have taken place. That land surfaces have been subject to elevation and subsidence is of course a common-place.

Upon questions such as those raised by Mr. Clement Reid, considering the authority with which he speaks, it does not become a layman in geological matters to dogmatise; personally, however, it appears to me more probable that sporadic and local oscillations of coast line have been the order of the day rather than a wholesale change of level.

Mr. Clement Reid instances in support of his argument the submerged plain off Selsey Bill, but the irruption of the sea over this area is an event within the historic period, as its present name of "The Park" indicates. The lands lying submerged to the south of Selsey Bill were, within historic times, a portion of the demesne of the Bishopric of Chichester.

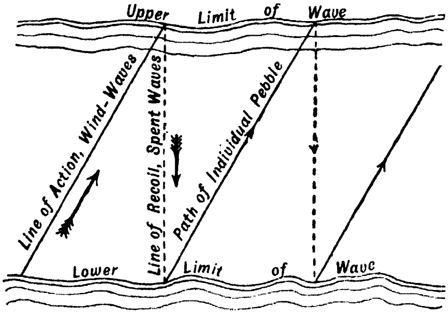
Mr. Reid further assumes that the above change in the relative levels of land and sea was completed about 3,500 years ago. At that date he states Stonehenge was being built. On astronomical grounds Sir Norman Lockyer, in his recent most interesting book on Stonehenge, gives 1700 B.C. as the approximate date of its building. Quite independently, on archæological grounds, Professor Gowland has fixed the date at 1800 B.C.

In the recent re-erection of the great fallen monolith at Stonehenge a number of stone tools were discovered, which had obviously been used by the workmen for dressing and socketting the masonry. These stone tools are unpolished, but Professor Gowland is of opinion that they are contemporary with the late Neolithic period. It would certainly appear that the evidence adduced on archæological grounds is slender.

Over large areas of the sea frontage of Great Britain, notably in the South Wales district, a change of approximately 60 feet in level has doubtless taken place within a comparatively recent and fairly defined period. Assuming that this change was widespread, it follows that, in advance of the present contour of sea and land, there must once have existed a coastal plain, and that a map of Great Britain of the period indicated would show an outer belt of low-lying land, intersected by deep-winding fjords. On geological grounds, Mr. Reid sees no reason why the present interlude of rest may not give place to further rapid oscillations of level.

Where seas are heavy and the foreshore is steep, the material of which the beach is composed is automatically graded. So well marked is this feature, that on the Chesil Bank for instance, a man thoroughly acquainted

FIG. 4.



TRAVEL OF PEBBLE.

with that singular ridge can in the dark, by picking up a few pebbles, approximately locate his position. The effect of the run of the sea on a beach is to produce a sieving action. As the waves impinge on a coast-line at varying angles they push the shingle backwards up the slope of the beach, and the recoil of dead water then drags a portion of the shingle down the sea slope by the path of least resistance, riddling out, under certain conditions, some of the larger stones. The normal line of travel of a particular pebble on the beach thus follows a saw-tooth path, alternately diagonal to and at right angles to the tidal lines. (Fig. 4.)

In a recent discussion Dr. Vaughan Cornish states the case thus: "If all the movements of sea-water, whether at the shore line or

elsewhere, are considered, it will be found that the principal part of the resultant movement is an unsymmetrical oscillation; that is to say, a long, slow movement occurs in one direction, and the water comes back to its former position by a shorter and quicker movement in the opposite direction. But though the two movements are equivalent, as far as the water is concerned, they are not so in regard to the transport of denser materials, which generally travel further in the direction of the shorter but quicker half of the oscillation." He then goes on to instance the Chesil Bank, and to show that the increasing coarseness of the shingle proceeding from Abbotsbury to Chesilton is due to the fact that this beach is sheltered to the east by Portland Bill, whereas from the West it is exposed to the waves, acting under the impulse of Westerly winds, thus driving all the shingle, big and little, towards Chesilton, whereas the waves produced by easterly winds have only sufficient velocity to drive the smaller shingle back towards Abbotsbury.

There is no department of engineering enterprise in which those in a responsible position receive more gratuitous advice than that of coast protection. Every longshoremen, as a matter of course, considers himself competent to offer an opinion, and often that opinion is well worth listening to. The only difficulty is, that boatmen and fishermen frequently have a rooted animosity to the construction of groynes, the reason at the back of their minds being the inconvenience and danger they are subjected to by concealed piling, in launching their craft, or on coming ashore. The fact of this animosity is apt to warp their judgment. At the same time they can often give much information which the charts or officials of a district may ignore. I am acquainted with a district on the coast of England, where, at an absurdly small annual cost, several miles of most difficult sea-frontage were maintained intact for years by the old coast warden, who had little except his mother wit and the evidence of his own eyes to guide him. Upon his death the foreshore in question was handed over to the tender mercies of an official of the new-light order. He carried out a series of measures on novel lines, with the result that the foreshore in question disappeared wholesale.

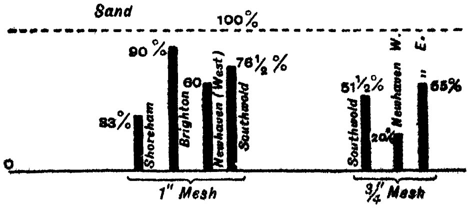
The movement of the column of drift on a foreshore is the resultant of the sum of all the forces that play upon it. Its contour may be moulded in a hundred different ways, but the dominant forces of wind and wind-waves define its ultimate shape.

On the East Anglian coast the most notable effect is that produced under the "swipe" of the N.N.W. winds,—to use the fishermen's phrase. A N.N.W. wind then drives the waves approximately parallel to the coast-line, and the scour they thus set up tends to rake out any defences at the foot of cliffs. On this coast a singular phenomenon may generally be noted, and that is a steep ridge of sand which varies in position from considerably above low-water line, to a distance of 500 or 600 feet outside this.

At Mundesley, near Cromer, this effect is well defined and visible. At low water a long channel of impounded water, about 3 feet deep, remains well above low-water line. This forms the hollow to a crest of sand seawards of it. These furrows are locally termed "lows." The effect, which varies in position and depth, is due to the off-scour of the sand produced by the wind-waves when dead on shore or nearly so. These drag the sand down the slope, heap it up to varying degrees, and form a sort of longitudinal bar. This bar affords considerable protection to the coast-line by cutting down the velocity of the waves, and wherever a gap, which is locally termed a "swash-way," occurs, there is a notable increase in their destructiveness.

It may be well to say a few words on the kinetic energy of the waves and their action under varying conditions. Sir John Coode has left it on record that on one occasion, on the Chesil Bank, a single gale scoured out 3,763,000 tons of shingle, and, after the gale was over, he took a series of cross sections of the eroded bank, which revealed the interesting fact that its shape was approximately that of an inverted parabola. On the same spot a laden sloop of 100 tons burden was, on one occasion, carried by a gale to a point 30 feet above ordinary high water.

FIG. 5.



SHINGLE.

At Skerryvore a pressure of 6,083 lbs., or about 2¾ tons per square foot, has been

registered by dynamometer. At Dunbar the observations have been as high as 3½ tons per square foot, and at Buckie, on the Banffshire coast, as high as 3 tons.

Where deep water abuts on an exposed sea marge, with an unbroken fetch, enabling wind-waves to acquire a high velocity, 2 to 2½ tons per square foot may be looked upon as not an extreme estimate of the force of impact of waves. This force, however, obviously varies with the angle at which it strikes. The flatter the beach and foreshore the greater is the skidding action on the waves striking it.

The mistake which is so often made in laying out measures for coast defence is founded on the idea that, because the sea has such tremendous power, therefore the method to arrest it is to erect a barrier, designed as a direct obstruction, with the object of neutralising the impact of the waves in the same way that a target does that of a bullet. For this purpose solid mass and weight have to be pitted against liquid mass and velocity.

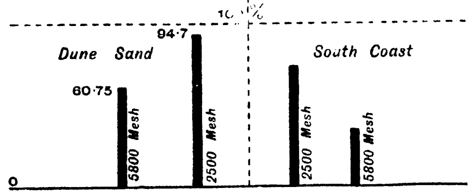
The mechanical effect of the blow of a heavy sea, striking a cliff or a sea-wall, is to hurl columns of water and spray upwards, and to set up a scouring action at the base of the obstruction.

The art of sea defence is to create and maintain upon a foreshore such a barrier of sea drift, either shingle or sand, as will absorb the velocity of the waves and bring them to comparative quiescence. Where shingle and sand form the barrier of arrest provided by Nature, measures have to be taken for maintaining them in a form best suited for that purpose. The construction of groynes is the usual expedient adopted.

Every river outlet or natural headland is in effect a groyne of greater or less extent. The guiding factor of a coast line, in relation to the travel of drift, is the wind dominant on that coast. Imagine a circular island surrounded by shingle, with wind action over a given period exactly uniform from every quarter. The components of the beach would, under these conditions, oscillate to and fro *ad infinitum*, marching, countermarching, and marking time, as the local forces acted upon them. At the end of the imaginary period I have indicated, their relative positions would be as they were at starting, except that their travel would have partly ground down the individual pebbles by attrition. As attrition proceeded, the circulating medium of defence of the island would change its angle of repose, thus varying the profile of conservancy. My suppositious case is pretty much on all fours with the littoral action on a well-groyned foreshore. There the natural travel, by reason of the dominant wind under the impulse of wind-waves, is arrested in detail, and oscillation, in the compartments between groynes, results.

The size of shingle on different foreshores varies very considerably. Large pebble boulders, as for instance those on Northam Ridge, may weigh up to 100 lbs. The size of ordinary shingle on the South coast is extremely variant. Thus, of the shingle of Shoreham harbour 33 per cent. will pass a 1 inch mesh; of that on the Brighton beach 90 per cent., and of that on the beach west of Newhaven 60 per cent. Taking a ¾ inch mesh, on the west side of Newhaven harbour 20 per cent. will pass, whereas on the east side of Newhaven 55 per cent. will pass this mesh. A pebble which will pass a 1½ inch mesh weighs about 1¼ ounces. On the east coast the shingle for the most part is practically small gravel. At Southwold, for instance, the percentage passing through a ¾ inch mesh is 51½ per cent.; 1 inch 76½ per cent., and 1½ inch 96 per cent. It is obvious that these variations will result in varying angles of repose.

Fig. 6.



SHINGLE.

The slope of a beach is modified, to an almost infinite degree, by the conditions of wind-wave and current from time to time prevailing. With a wind off-shore and normal conditions, it will be found that shingle on a beach will be heaped up, whereas with a wind on-shore the shingle on the beach will be dragged down. Where a slow ground swell strikes a coast line, with a sea of oily smoothness, a series of ridges or "fulls" are rapidly formed. The object of groynes is to divide a given foreshore up into a series of short bays and prevent the sea-drift being diffused over an extended area, so that its travel is reduced within compass of control.

From the foregoing remarks, I think the reason of the rule which is almost an established one on normal foreshores, *i.e.*, to

groyne at right angles to the coast-line, will be obvious. Of course special conditions of exposure and shelter may render it desirable to modify the angle of groyning, to attain a maximum of effectiveness. The prime consideration is to so arrange groynes that the contour of a foreshore shall be as little irregular as possible. A sea beach protected by a series of groynes resulting in big differences of level, on the windward and leeward sides, is evidence of bad design. It is obvious that wind-waves will heap the shingle on the windward side, and tend to scour the shingle away from the leeward side. By keeping the top of the planking of the groynes approximately at the height of the normal slope, this effect may be largely obviated. For this reason, in the majority of cases, concrete groynes are not desirable. With a timber groyne it is easy to take off or add to the planking, as the shingle alters its level, and it is thus possible to humour a beach and keep it tolerably constant in contour.

With a concrete structure the result is that, if it is built low, it is completely buried, and large quantities of shingle escape to leeward. At Hastings, for instance, a massive concrete groyne or pier is run out under the East Cliff, and the shingle heaped up against it to a level of about 22 feet above Ordnance datum. Immediately to the East of this again, there is a drop of some 20 feet on to the bare sandstone rock, which is being worn away by the scour of the sea. The cliffs beyond are not only bare of shingle, but themselves being severely attacked, so that landslips frequently occur. The tendency in all towns is to erect, what I may term, "long-stop groynes." The argument is: "This is the limit of our territory. Let us make sure at this point that we arrest every ton of shingle reaching us, and the folks beyond us must look after themselves." This is often a short-sighted policy. Taking Hastings as an instance, the Corporation have acquired the East Hills as a golf and recreation ground, and the authorities are considerably disturbed at the inroads taking place.

Wherever a line of coast exists the defence of which is a shingle barrier or a sandy flat, and in rear of which are marsh lands or a district easily flooded, it is necessary to construct a sea-wall or other fore-and-aft barrier, which will prevent in extreme gales the crest of the shingle being driven inland with a flat slope, and thus for all effective purposes being practically lost.

In no department of engineering practice is it more true than in that of coast defence, that the locality which hesitates is lost. In many instances had effective means been taken in good time, a frontage could have been saved at a fraction of the actual ultimate cost involved by tardiness in carrying out defence works.

This is one of the great factors in the present situation. I have brought the subject in this light before the notice of the Royal Commission on Coast Erosion now sitting. The difficulty of securing prompt and united action under present conditions, points to the urgent necessity of statutory reform. The measures which I have suggested I will detail later.

There are long stretches of the English coast-line in which the shingle and sand, forming the barrier of arrest, are backed by earth embankments.

I have personally to watch and advise measures of protection for over 60 miles of coast-line of this description. The great feature, in defences of this class, is to put the embankment well in rear of the foreshore. The shingle is thus forced back until its motion is arrested by the embankment. The shingle bank then becomes automatically moulded by the operations of Nature into the most effective contour for neutralising the momentum of the waves.

In situations of great exposure embankment walls would be futile. It is needless to say that, to be successful, there must be an abundance of the travelling medium of defence on which their efficiency depends.

The height to which a shingle barrier will be raised, under the conditions I have just indicated, varies considerably on different coasts. It varies as the tidal range varies, and also with the size of the component parts of the material in the slope.

The normal crest of a shingle bank, such as that between Newhaven and Seaford in Sussex, is about 20 feet above Ordnance datum (or mean sea level), the mean range of tide being 16 to 20 feet. Exceptional gales and tides will increase the height to which the beach is thrown, to a height of about 25 feet above Ordnance datum.

At the East end of the Chesil Bank the top of the shingle bank is 43 feet above high-water level.

On the East Anglian coast, where the coast-line is very steep-to, and the shingle is smaller in size, the range of tide in some localities being only 6 feet or 7 feet, the normal level of

the crest of shingle thrown up by the seas is only about 12 or 13 feet above Ordnance datum.

Turning now to a coast-line which depends for its protection on sand, the character and the fineness of this sand are important factors. Not only does sand consist of minute particles of flint, and other rocks ground to powder by the attrition of the travelling beaches, but it is often largely composed of broken shell. Its buoyancy in this case is obviously much greater. On the other hand, shell-sand if powdered very fine, will actually have a heavier specific gravity than quartz or felspar sand, the reason being that the interstitial cavities represent a much smaller proportion of the total volume in the one case than the other. Dune sand has a residue of about 5·3 per cent. on a 2,500 mesh sieve. On a 5,800 mesh sieve the residue is 39·25 per cent. Ordinary South Coast sand has a residue of 30·6 per cent. on a 2,500 mesh, and 72·75 per cent. on a 5,800 mesh. With coarse sand, fifty particles are about equal to one linear inch; of dune sand, about 100 to 150 particles are equal to one linear inch.

In still water the finest quartz sand drops to the bottom almost instantly, but a three or four knot current will disturb and oscillate normal sea sand. This is obvious on every sandy sea coast, where the line of sand-bearing water is visible under the tidal movement. The general slope of sandy beaches is about 1 in 30 above low water, and below this about 1 in 50, gradually flattening to about 1 in 100.

It was on a walk from Nether Stowey to Dulverton, in the autumn of 1797, that Coleridge, Wordsworth, and Dora Wordsworth evolved the lines—

> "And thou art long and lank and brown,
> As is the ribbed sea sand."

The haunted figure of the Ancient Mariner stands revealed in this image of a lonely and desolate sea marge.

The peculiar chequered appearance of sandy flats is familiar to everyone, but when one begins to think why sand should assume this particular contour, it is at first not easy to see any adequate reason. Wind action is, of course, the compelling force. This can be simulated by means of an artificial sand blast, and in miniature a ribbed sea sand can thus be moulded. The action of the blast affords a key to the problem.

Examining the effect of such an experiment, it will be found that the first essential to produce sand rippling is the absence of uniformity in the sand itself.

Take a sample regular in size and specific gravity, and, vary the intensity of the blast as you may, no rippling will result. It is clear, therefore, that the phenomenon is due to an assortment or grading of the sand grains. They are lifted and built up in regular sequence, the smaller or lighter particles being winnowed out, and tossed upwards on to a foundation of larger or heavier grains. A casual examination shows that the windward and leeward sides of these toy dunes are dissimilar. The former are flat, lying at an angle of perhaps not exceeding four degrees to the horizon and convex in form; the latter steep, lying approximately at the angle of repose of the material, and concave. They are heaped up by reflex action. The wind flowing in lines parallel to the surface, when it passes the crest of the slope, sets up a return eddy and thus lifts the lighter particles to the top of the ridge. Thus the ridges grow in height. The shifting and variation of the wind produce infinite combinations in ripple pattern. When one ripple flows into another, a double series of valleys results. When two ripples unite, the thinning of the leeward ripple, at the point of junction, is due to the *cul de sac* thus formed.

Moving sand plays extraordinary freaks. The fuljes of Arabia have been compared to gigantic horse tracks. They are horseshoe-shaped pits in the desert, gouged out at the crown to great depths. Mr. W. S. Blunt estimated from his measurements one of these to be 280 feet deep at the point. From this they slope up to the level of the desert, in a long wedge, and a crest or lip, above desert level, is to leeward of the crown. Imagine a uniform wind blowing across a sandy plain, in which here and there amongst the sand-waves are strewn solid obstructions, such as heaps of boulders. Where these lie the wind will, under certain conditions and intensity, scoop out hollows. Excavation thus goes on progressively, so long as the wind conditions favour it. Just as deep pools are dug by the waves at the base of projecting rocks or crags, so does the wind carve out and deepen the fuljes in the desert. The bottom of these pits is a hard substratum or platform, by which the digging action is arrested. Having thus reached a limit of depth, sand movement may forge ahead, causing the fulje to travel onwards in the direction in which the wind is blowing. Now let the wind slacken or shift, driving light

powdery sand before it, and this will gradually smooth out and obliterate the ridges, leaving only isolated pits, with sand lips at their front. Thus apparently have these strange basins been formed.

Sand may be a useful slave, but it is an exacting tyrant. On the coast of England and Wales are many wide stretches of dunes, which form effective buffer tracts between sea and land. In Holland, on the West coast of Denmark, and the South-West and other coasts of France, these barriers, which "serve them in the office of a wall," are jealously guarded by State enactment. In England we do things in a more happy-go-lucky fashion, but the law of the question of coast defence of the United Kingdom from erosion by the sea is worse than no protection to frontagers, and will have to be overhauled and remodelled.

Not the least of the matters to be regulated will be the systematic planting and cultivation of sand ranges in the Dutch fashion. Marram (Gaelic "Murran") grass (*Ammophila arundinacea*) is the bond most favoured.

The science and art of planting land reclamation and sand slopes, as a measure of maintenance and defence, have not received anything like the attention their importance deserves. It has been rather the fashion to despise these simple measures. The plant population which springs up on the muddy shores of reclaimed land or on sandhills, even down to high water level, is of the most varied character, and cattle will not touch many of the grasses most useful in binding sand slopes. Sea lyme-grass (*Elymus arenarius*), though rich in sugar, is one of the grasses cattle avoid.

It is hardly necessary to refer to shrubs like the Tamarisk (*Tamarix gallica*) and sea buck-thorn, the planting of which is so common a feature in watering-places.

Amongst the plants which thrive specially on muddy shores and salt marshes may be mentioned the black salt-wort (*Glaux maritima*), the various species of Atriplex or sea purslane, also the sea carex or sedge, and various species of sea thrift or *Statice.*

Of plants which thrive better on sandy sites may be named the yellow-horned poppy (*Glaucium luteum*), the sea holly (*Eryngium maritimum*), the prickly salt-wort (*Salsola Kali*), the various species of sand-wort, the sea pearl-wort (*Sagina maritima*), sea barley, sea wheat-grass, and sea cat's tail.

A very large number of grasses thrive on the fringe of high-water mark, and these nearly all possess long fibrous roots which penetrate enormous distances through the sand to reach a moist soil. The effect of this characteristic is that they mat together and anchor the slippery sand slopes, thus preventing them from being disturbed by wind action or beaten down by heavy rains. A cliff slope thoroughly overgrown with sea bindweed (*Convolvulus soldanella*) is almost impervious to this kind of action.

A systematic study of the whole problem, the careful cultivation of the grasses most valuable for the various purposes required, and the machinery for systematic planting will be matters of first-rate importance, when an organised campaign is instituted against the evils of coast erosion.

Quite recently evidence of much value has been given before the Royal Commission by Lord Montagu of Beaulieu, who described the accidental sowing, on certain mud banks in Southampton water, with the South American Nei grass, the result of which has been the reclamation of large areas of swampy ground upon his lordship's property.

Dun in Gaelic and Anglo-Saxon, meant merely a hill, but, so large a part did the sand barriers of the coast play, that the word has been monopolised to them alone. Its original meaning lingers in many a place-name. In the Lowestoft district it has become "the Denes." The Danish invaders called the sand ramparts "meols" or "meals," and this is still their regular designation in Northumberland and Lancashire.

Under steady wind action these dunes, or meols, sometimes slowly and irresistibly travel, burying towns and villages in their march. Similarly they have been known to oscillate back again, disinterring that which they had beforetime shrouded. The bonding power of the marram, or mat grass, is astonishing, and, so fully recognised was its value in fixing the dune slopes, that, in the reign of George II. a law was passed rendering it a penal offence to cut or injure the grass. Considering its usefulness for the purposes of thatching, and the making of mats and brushes, its protection by the enforcement of this law is most necessary.

In localities like the Persian Gulf and the N.E. kuckle of Brazil, blown sand is the dominant factor of the entire situation. The Persian Gulf is rapidly shoaling by reason of the vast quantities of sand travelling from the desert regions of Southern Persia. An almost perpetual condition of sand storm exists in certain localities. In the Arcachon district,

before protective measures were taken, there have been instances in which pedestrians have been smothered and buried by sand blizzards. A miniature desert plateau was beginning to form in that quarter of France. The French Government, however, took the matter vigorously in hand. About 200,000 acres were planted, principally with the *Pinus maritima*. The sea lyme-grass (*Elymus arenaria*) has also proved a useful ally. The entire district has been transformed by the measures taken. The travel landwards of the dunes has been arrested, valuable forests have been called into being, and the sand flats, instead of being a scourge and a nuisance, have become a health resort. Conversely, the pulling up of the marram grass on the Coubin estates, near Forres, in Scotland, in 1769, caused the devastation, in a single season, of an estate worth £300 per annum. Similar vandalism on the West coast of Jutland brought back a plague of sand there. Equilibrium in this and so many other cases goes hand in hand with the conservation of natural agencies. On the Dutch coast it is the practice to plant pines in rear of the sand dunes. These, when grown to maturity, arrest and precipitate the sand which otherwise would spread, like a cloud of locusts, inland of the coast line, carrying devastation far and wide.

The best object-lesson in the protection of sandy foreshores is that afforded by the work carried out on the Belgian, Dutch, and West Danish coasts. The groynes at Ostend are built of fascines, and run at right angles to the foreshore. The fascine work is 26 feet wide at the upper end, and 40 feet wide at the lower end. It is held down by stakes about 5 feet long, driven a few feet apart. Between the stakes blocks of stone are laid. On other parts of the Dutch coast, mattress-work, made of willows interlaced around piles, is employed, and upon these matttresses 18 inches of rubble basalt is laid. In many parts of the Dutch coast scupper nails are used to protect the timber work from the teredo. Generally speaking, one may say that the Dutch methods depend for their efficiency on the use of clay, brushwood, and block of stone, held in position by piles, or fir poles, driven into the foreshore. Under normal conditions the life of these groynes is stated to be 20 years. In Schleswig and Holstein, however, long groynes are employed as a protection to the sea dykes. They have to be extended from 430 to 560 yards seawards, and on this coast cause a heaping of the sand at the top of the foreshore. These groynes are 2 or 3 feet high, and 4 feet wide, and are formed of earth with interlacing matting. The slope on the windward side is 4 to 1, on the lee side 3 to 1. It will be obvious that measures of defence such as these would be useless on a sea coast of severe exposure, where deep water came close in.

Having thus passed in review, in the briefest way, the general conditions of the problem of coast protection, I may perhaps give instances of recent practice on the English coast. The constructive works which a foreshore engineer has to devise are groynes and sea-walls, or other fore-and-aft defences, where the land in rear of the foreshore does not afford the support necessary to hold up the bank of shingle or other drift. One most important matter to consider is that of the drainage of the land contiguous to the sea front. It is perfectly clear that, with a foreshore such as that near Herne Bay, where Tertiary clays and gravels are combined in varying layers, a wet season will work havoc with the line of cliffs. The water accumulates and lodges in the natural basins formed by the clay, and, oozing through some fissure or vein of porous material, brings down great masses, especially after frost. Meantime, the fret of the waves at the foot of the cliffs tends to cut away the support for the cliff and accelerate land slides. No measures of coast protection will prevent such weathering from above.

Along the East Anglian coast, where landslides are disastrous in extent, a slip-shod way of draining lands abutting on the sea prevails, and materially assists the work of destruction. There is no inducement to a landowner to spend money on land which next year, or next month, may tumble into the sea.

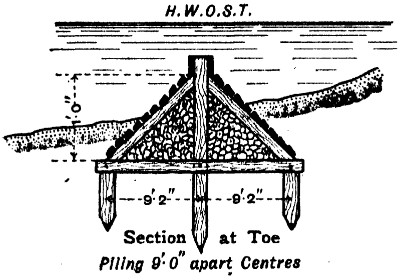
Some coast lines are peculiarly liable to be disintegrated by frost. Chalk cliffs, provided they are nearly vertical, will resist this action for a long period. Moisture falling upon chalk land gets away quickly, chalk being a most absorbent material. The worst that happens generally, if the cliffs are vertical or nearly so, is a slight weathering of the skin of the face of the cliffs. Where, however, chalk headlands stand at a moderate slope, they are more likely to give trouble, owing to the percolation of the water into the fissures in them.

The sandstones do not come off so well. Many of the loosely-knit sandstones are liable to be split by water penetrating into veins, freezing, and thus wedging off great masses. This question, however, is rather alien to the

immediate matter I am endeavouring to deal with, viz., coast defence.

At Bridlington, in Yorkshire, five "A" groynes, similar in section to Fig. 7, were built in 1868, and two of them still exist.

FIG. 7.



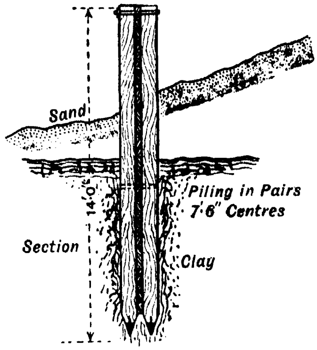
"A" GROYNE, BUILT AT BRIDLINGTON IN 1868.

At the top, or sea-wall end, the groynes were built 12 feet above the level of the foreshore, and at the bottom end 4 feet. The frames are 12 inch by 6 inch timbers, filled with block chalk and the sides are inclined to 35°. The piles are 12 inch by 12 inch, and the planking 9 inch by 4 inch. This type of groyne embodies almost every principle to be avoided. Being built to an arbitrary level above beach level, such groynes accumulate drift on the windward side and cause deep steps in the foreshore, which are unsightly, inconvenient and dangerous. Being built almost broadside to the sea, they set up scouring forces of the most formidable nature, forces not of conservation, but of destruction. Lastly, the cost of a groyne of this type is of necessity heavy. Groynes of a somewhat similar type have been constructed at Trusthorpe and Ingoldmells, on the Lincolnshire coast. In that case the transverse section of the groyne showed five rows of piles each 7 inch square, spaced 5 feet apart. The centre portion of the groyne rose about 3 feet above the sides, and the slope of the sides was 22½°. These latter groynes have retained the drifting sand, but on this part of the coast the sea is receding, and the problem is rather that of preventing inundation than of stopping erosion.

I remember an instance under which promenade works were built under these conditions. A contractor friend of mine, who attended the inaugural luncheon of the sea wall from which the sea was withdrawing, summarised the situation by saying that it appeared to be a case in which "the sea saw it and fled."

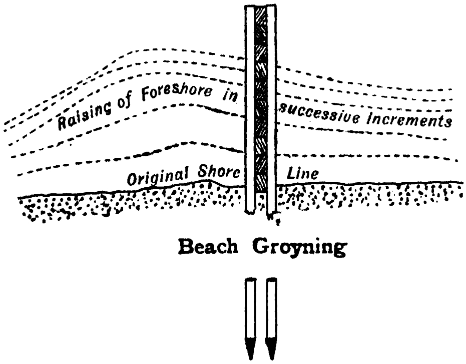
The type of groyne which, under normal conditions, I find most effective is that now to be shown. I have recently carried out the defences of a corporation in which the ravages of the sea were extreme, by building a series of groynes of this type. The piles are 10½ inch by 10½ inch, driven in pairs, 8 feet centre to centre, leaving a space for 4 inch planks, to be bolted between. Owing to extreme severity of the conditions, the piles had to be about

FIG. 8.



ADJUSTABLE GROYNE.

FIG. 9.



Beach Groyning

21 feet long. The planks bolted between the piles are arranged to break joint. By carefully watching the accumulation or depletion of moving shingle and sand, and by taking off or adding planks, as the state of the foreshore indicates the necessity for doing, an effective sea beach can, by groynes of this type, be coaxed into existence. A few tides' neglect may however undo the accumulation of weeks.

These groynes have cost about 28s. per lineal foot to construct.

On less exposed coasts in which the piles need only be say 14 feet long, the cost of similar groynes is about 18s. per lineal foot.

Taking 15 groynes to the mile and assuming each groyne to be 100 yards long the cost per mile for groynes, such as those at Hove and Hastings, which are massive and high, and have oak ties, would be about £10,000. Somewhat similar groynes but with struts instead of oak ties, such as may be seen on the Cromer coast, cost about £8,500 per mile.

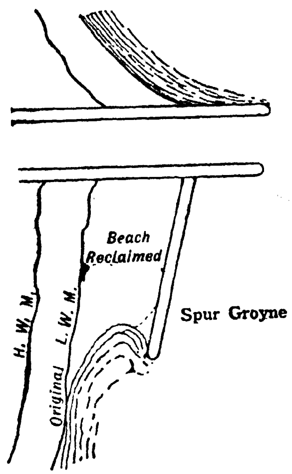
Low groynes of the single pile type like those at Felixstowe and Worthing, cost about £1,250 per mile, and similar groynes, but with double piling, vary from about £1,500 to £2,000 per mile, according to the length of piling necessary.

I may perhaps, in passing, mention that there have been several patent claims for groyning, notably that of the late Mr. E. Case, who was the engineer of the Romney sea defences, which are secured by the Dymchurch wall. His patent (1896) was, however, upset in the Court of Appeal. His method of constructing groynes was to fix uprights in pairs. They were of a light character, and held in position in the beach by being concreted into excavated pits. The planking was bolted between the pairs of uprights. In the coast protection works at Dymchurch Mr. Case was undoubtedly highly successful. He advocated building groynes from the lower part of the foreshore upwards, but did not carry the groynes so far as the top end of the sea-wall, or other fore-and-aft protection work. This latter arrangement often results in dangerous scour round the head of the groynes, and in my view is undoubtedly a mistake. On exposed frontages the Case system has been of doubtful utility, as the concrete bases, into which the uprights are bedded, are liable to be scoured out. In this case the entire groyne comes to grief.

The effect of successful groyning on a steep foreshore is that the slope of the shingle, forming the foreshore, is flattened, and, in order to produce a satisfactory contour, it is therefore obviously necessary that shoaling should take place beyond the original line of low water. It is, therefore, necessary that the groynes should be carried below low-water mark, and this extension (when deep water originally existed close inshore), is the measure of the efficiency of the groynage. To extend groynes below low water, it is either necessary to drive close sheet piling, or to take every opportunity as the beach increases, to add planking, and thus to push the structure seawards, by degrees.

The advantage of the expedient of spur groynes (*i.e.*, groynes running from a given structure parallel with the coast line) is one of which an instance may be seen immediately to the south of the entrance to Lowestoft Harbour. A spur groyne is local in its effect. Its object is to afford protection to a short length of frontage, generally to some extent at the expense of the frontage to leeward of it. Where, for instance, entrance piers run out into the sea, on the windward side of which the travelling shingle is arrested, scour on the leeward side is a natural consequence. By means of a spur groyne the root of a leeward pier may be protected, as behind it shingle, sooner or later, gets driven, and permanently lodges, being sheltered from scour by the spur groyne.

Fig. 10.



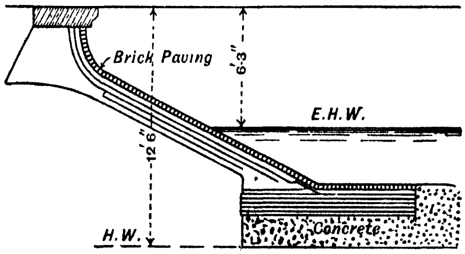
Turning now to the question of sea-walls, it is hardly needful to say that they vary in type within wide limits. As a rule, sea-walls are built fair on the face with a batter of 1 in 6 or 1 in 7. At Scarborough the sea face of the wall is curved to a radius of 17 feet, and the toe projects 15 feet beyond the bottom of the curve.

There are many other instances of sea-walls with curved fronts. I may mention that of Scheveningen, on a sandy coast. The apron of this wall is 20 feet long, it batters 1 in 4, and rests upon mattress work and clay 18 inches thick. (Fig. 11.)

Another common expedient, which has been adopted at Hastings and Blackpool, is that of having a projecting bull-nosing at the top of the wall. The idea of this design is that a column of water shot upwards under a wave stroke will be driven off at a tangent, away

from the Esplanade. So, to a large extent, it will, but the strain thrown on the wall is proportionately severe. Then there have been numerous designs for walls with stepped fronts, such as that for Bridlington and Margate. The Margate wall has a most elaborate contour consisting of a series of steps, each with rounded copes.

FIG. 11.



SCHEVENINGEN SEA WALL.

The idea embodied in the design of these various structures is that of breaking up the forces acting upon the wall, and making the details of these forces mutually destructive. The forces operating upon a sea-wall consist of horizontal direct blows of the waves; these, by deflection, set up vertical forces acting upwards, and similarly vertical forces acting downwards. The effect of the last is to excavate and tear out the root of the wall. The upward vertical force is one of the most fruitful sources of destruction, by reason of the cascade of water which thus passes over the sea-wall, and scours out the filling behind it. It thus sometimes digs a trench into which the wall is capsized inwards.

The conclusions which I personally have arrived at are that to build sea-walling, unless under conditions which will result in its being well-clothed with shingle or drift in front, is merely to court disaster. Such structures form admirable excavators. The weight of water rushing up the face of the work will on recoil set up dangerous scour at the root of the wall. Many such a structure has come to grief in this way. It cannot be too much emphasized that the object of a parade wall is that of forming a barrier for the travel of shingle inwards, rather than constituting a barrier for the wave stroke itself. Considered from this standpoint, it seems to me obvious that sea-walls of elaborate section involve a wasteful expenditure of money. The simplest and cheapest type appears to me the best. Such a structure is an ordinary wall of concrete, if necessary faced with granite, vertical on the front and stepped at the back. The best sea-walling, I may repeat, is a massed sea beach, and if sea-coast towns would be content not to push their building line so far forward, but to let nature build them a protection with the aid of a suitable system of groynes, they would, in nine cases out of ten, be in a far better position than they are when endeavouring to build sea-walls so as to encroach on the natural frontage of protection.

The latest practice in coast defence is that of dumping shingle artificially on a beach which has been depleted. The effect of this is often to restore efficiency and re-create a protective barrier. Some twenty years ago the sea-wall at Hove, immediately after construction, was seriously endangered by underscour. Twenty-seven thousand cubic yards of shingle were brought from Shoreham by barge and deposited as close inshore as possible, groynes were constructed, and the wall thus saved.

Similarly, between Newhaven and Seaford aoout 71,000 cubic yards of shingle were brought in railway waggons and tipped on to the beach between the groynes, and the result has been the successful protection of a length of low, exposed coast.

The question of coast erosion is one of urgency and of increasing urgency. The situation in many districts is so intolerable that some comprehensive national scheme must be evolved without delay. There are tracts of coast-line on which the invasion of the sea is a contingency continually present to the landowner and occupier. Slipshod agriculture is the natural consequence. The individual landowner may spend freely on defence works and find himself outflanked by the neglect—or more probably by the excess of zeal—of his neighbour. The principal areas of erosion are as follows:—

On the East Coast.—The Lias cliffs between Scarborough and Whitby, the coast line between Bridlington and Spurn Point (glacial drift), the East Anglian coast line from Cromer to Clacton (glacial drift), the Kentish coast from Herne Bay to Ramsgate (mostly tertiaries).

On the South Coast.—The Hastings sand cliffs near that town, the chalk cliffs between Newhaven and Brighton, points at the East and West ends of the Isle of Wight, the Oolite coast line between Swanage and Weymouth, the Lias cliffs near Lyme Regis.

On the West Coast—Points in Bridgwater

Bay, Somersteshire, in Cardigan Bay, on the North Wales coast near Colwyn, the Lancahire coast near Blackpool, and other localities.

A Royal Commision is now sitting to take evidence upon the entire matter and is investigating the subject with admirable thoroughness. I have, at the request of this body, furnished a memorandum of the legislative measures which the present situation seems to me to call for.

My proposal is for the creation of two Central Bodies to deal specifically with the problem, one taking charge of the entire coast of England and Wales, the other of the entire Irish coast. Such bodies should act with much greater economy and efficiency than now obtain. The present régime of local control is often wasteful and sometimes actually pernicious. I suggest that the Coast Commisioners should take over the powers and functions of the various bodies now controlling sections of the coast under Statute, and also the rights and powers of the Government Departments affected. The body of Commissioners in each case should not, I think, exceed five, as any large representative body would only perpetuate the evils of the present lack of system. The Commissioners I suggest should be appointed respectively by the President of the Board of Trade and the Chief Secretary for Ireland. The Coast Commissioners would nominate and appoint District Engineers or Coast Wardens, whose functions would be to advise Coast Commissioners as to the measures necessary for the maintenance of their respective coastal frontages, and the execution of such works as might be ordered by the Coast Commisions.

I further suggest that the coast line of Great Britain might be conveniently divided into the following districts :—

(1). Berwick-on-Tweed to the North shore of the Humber.

(2). The South shore of the Humber to the Essex shore of the Thames.

(3). The Kent shore of the Thames to Poole Harbour.

(4). Poole Harbour to the Severn.

(5). The Welsh coast.

(6). The Dee to the Scottish border.

The Irish coast might be divided into three or four sections.

The administrative functions of the new bodies would be the investigation of the titles, rights and obligations of the various authorities, landowners and others claiming jurisdiction or rights over lands contiguous to high water line and between high and low water levels. They would have authority to stop the removal of shingle or sand from a foreshore; and I have suggested that, should it not be proveable that such right had been exercised within 21 years, no compensation should be payable.

For the purposes of coastal defence my suggestion is that the Commissions should be the sole authority, with the proviso that their functions be restricted to works intended and designed primarily for the defence of lands and towns against sea erosion.

With regard to the thorny question of how the bill for the works carried out is to be met, my suggestion is that the salaries and expenses of the Coast Commissions and of their executive officers should be defrayed by an annual Treasury grant, and that the Treasury should further provide a capital sum to cover the plant necessary for the operations of the Commissions. This would be all that the Treasury would be called upon to find. The actual cost of works, carried out by order of the Coast Commissions, should I think be defrayed in respect of two-thirds by the County Council or Councils of the locality which includes the site or sites of the respective works, and one-third should be borne by the Corporations or local Councils whose frontages would be immediately affected. Public enquiries in every case would be held before any scheme of works was determined upon, and local views would thus be considered.

The main argument in favour of the suggestion which I have ventured to put forward is that a policy of prevision would take the place of the present lack of policy and of mere hand to mouth expenditure under panic.

The Coast Commissions would be able to utilise the surplus deposits of shingle and sand in one locality to make good the deficiency in another. It is on the maintenance of the circulating medium of defence provided by Nature, either thus or by natural travel, that the security of the entire coast line depends.

There are various precedents for the formation of bodies such as I suggest, and the broad conclusions which I have arrived at are the results of long experience.

In conclusion, I desire to express my thanks for the attention which you have been good enough to give to my imperfect development of a wide subject.

One often hears it said, "Sea Defence Works are generally expensive; coast land is often cheap. Let the cheap land go." It seems to me that from a national standpoint, such a creed is unworthy of the people, whose race-character springs from the mastery of the seas.

DISCUSSION.

The CHAIRMAN, in inviting discussion, said the author had given some very interesting information upon what was really a subject of national importance. Coast erosion unfortunately had a very serious effect, and it meant the loss of many acres of land to the sea, every year.

Lord MONTAGU OF BEAULIEU endorsed what the Chairman had said as to the ability of the paper. He had himself practical knowledge of sea defence work, and it had been a subject which had interested him very greatly for some years past. He therefore appreciated, perhaps to a fuller extent than some present, the arguments which the author had put forward. The author had referred in his paper to the evidence which he (the speaker) gave before the Royal Commission, with regard to a particular grass, called *Spartina altemiflora*, a grass which grew on the mudflats in the neighbourhood of Southampton Water. That grass had spread with amazing rapidity and persistence from the mudflats near Portsmouth to Hurst Castle, a distance of something like twenty-five miles. The grass, the origin of which was shrouded in mystery, was more like rice than anything else; in fact, in some cases it was more like immature oats. It grew in circular patches and spread. The remarkable point was that it would grow below high water mark, and on mudflats which were submerged twice a day by ordinary high water. He thought the author would agree with him when he said that he did not think there was another grass which would grow below high water mark. Of course, there were innumerable plants and reeds which would grow above high-water mark, and the author had mentioned one or two as arresting the progress of blown sand. Those were well known, but, as far as he personally knew, no other plant would grow below high-water mark in salt water or in estuaries. The grass helped to accumulate all kinds of detritus, and eventually raised the level of the mud above high water, therefore forming practically what was new land. He had had the history of the grass investigated, and only the previous day he had received a report on the grass from the Director of Kew Gardens. The report described it as being *Spartina altemiflora*, or *Spartina srpicta*, or, in some cases, *Spartina Townsendi*, there being three kinds. It was rather an interesting fact that all cattle liked it, it being sweet and full of sugar. It was, therefore, a useful grass for feeding cattle. Rabbits also were very fond of it. The report mentioned that the records of such grass extended over many years; but the first record he personally found of it was about the year 1833, when it was mentioned in some Hampshire records as having existed at what was then known as Itchen ferry, on what was now known as the Woolston shore of Southampton Water. It certainly did not exist on the mudflats in the Solent until within the last ten years. He could recollect when there was none in the Beaulieu River, which was a large estuary; but it was now entirely choked up with it, although the main water-way was as open as ever it was. He could not help thinking that the grass would be a most valuable addition to the means of reclaiming mud and sand flats near the mouths of rivers. He did not know how it would act in very exposed places; but he had noticed in the Solent when there was a considerable sea on, and where the grass grew down to the water's edge, that when big waves came in it seemed to withstand their action very much better than where the mud existed without grass. It might lead to the recovery to a great deal of land on the East Coast of England, in the mouths of the Thames and Medway, and along the Lincolnshire, Norfolk, and Suffolk coast. In his experience groynes must always be considered in relation to shingle travel. It was well known that a glacier instead of being motionless moved at a regulatar rate of progression; and shingle did the same. It might move very quickly in a year of great storms, and at a slower rate in years when there were fewer storms, but shingle on the shore was a continually moving body. If groynes were put up at right angles to the sea and not parallel to it, the first effect seen was that the groynes filled up gradually owing to the flow of shingle, until the shingle came to the top of the groyne; then it fell over like a waterfall, and filled up the next space, till the whole shore was covered. For over a hundred years past the foreshore on his estate in Hampshire had been defended in that way. The groynes had been constructed of ordinary fir or oak timber, 1 foot to 2 feet in diameter, driven down into the shingle for a couple of feet, and projecting in some cases as much as 6 feet on the leeward side of the groyne. The result had been that, when they were kept in order, erosion had been averted. He had recently had some photographs taken showing how, viewed from the westward, there were hardly any groynes to be seen, while from the eastward every groyne was visible, owing to the travel of the shingle in the English Channel taking place always from west to east. He thought the author would agree with him that, as a general rule, shingle always moved in the direction of the flood tide. It seemed to be a universal law that shingle moved in the English Channel from west to east, which might be attributable to the prevailing wind; on the east coast it moved from north to south, which also might be attributable to the prevailing wind; but he believed the flood tide had as much to do with it. The result was that if the flow of the shingle could be arrested, a perfectly sure sea defence was gradually formed. He agreed with the final sentence of the paper, that it was not worthy of England as a nation to say that, as the land was not worth much, they might let it go because the expense of preservation was greater than the land. He thought people from the overcrowded parts of the cities might be usefully employed in the reclamation of the lands round the sea coasts. On his estate he maintained 132 groynes,

which required renewing every 10 or 12 years. There was one agency in piling up shingle on shore the author had not mentioned, namely, the pod-weed. It began by growing on stones between high and low-water marks; in a short time, when it reached from 4 inches to 6 inches high, it developed at its ends tiny little bladders, which grew larger and larger. The gradual rise and fall of the water with the tide loosened the stones to which the weed was attached, as it was always pulling up. There came a time when the pod-weed was sufficiently powerful to float the stone up from the bottom; this might happen when there was an on-shore wind, in which case the stone was deposited on the shore at the utmost limit of the wave action. He had a very interesting collection of photographs, which he had had made for the Royal Commission, showing the various stages by which that was done. The question raised by the paper deserved national attention. The Royal Commission would, he hoped, do some good, but he felt there was a great absence of knowledge of how to defend the coasts against the inroads of the sea. If the author could get his paper circularised in a popular form, he thought there were many owners on the coast who would be only too delighted to know where they could get some practical sound advice on the question.

Professor Boyd Dawkins, F.R.S., remarked that for many years past he had studied coast erosion in various parts of the country, and had been filled with amazement to notice the extraordinary methods taken by engineers to meet the attacks which the sea was making on the coasts. In the next place, he had been surprised at the extraordinary apathy of those people who were most interested in maintaining this island at its present size or enlarging it. He fully accepted the principle laid down in the paper with regard to the correct construction of groynes. The present high, elaborate, and massive groynes formed an element of danger to the coast rather than one of defence. The principle of small groynes, raised to a few feet above the general level of the shingle or sand, was a principle which had been thoroughly proved to be the true one in all the cases which had come before him during the last thirty years. On the coast line between Brighton and Newhaven there was a series of large groynes with the shingle piled up on one side, and, owing to the waterfall action of the waves breaking over the groynes, they were being excavated on the lee side. The result was that, between Brighton and Newhaven, the coast was going by leaps and bounds, and areas which were formerly shingle and sand were now masses of bare chalk. Mr. Henry Willett, a friend of his, owned a small portion of land at Rottingdean, to the east of Brighton, and, being fully persuaded that low groynes were the correct thing as opposed to large groynes, he put in, for the defence of his own property, small groynes raised about two feet above the level of the sand and shingle, the result being that that was the only area which presented a bit of sand and shingle between Brighton and Newhaven. The coast-line between Folkestone and Dover was going by leaps and bounds, because the massive pier at Folkestone prevented the natural drift of the shingle, the coast being left open and naked to the dash of the sea. In his opinion it was more than the South-eastern engineers would be able to do to preserve that coast line for the sake of their railway. The development of the Admiralty Pier at Dover had blocked the drift of shingle in the direction of St. Margaret's, the result being those alarming land slips which were so rapidly diminishing the area of the land in that district. These were illustrations of the absolutely wrong action taken by engineers in attempting to arrest the drift of the shingle by large and massive barriers. As an illustration of the principle laid down by the author, a friend of his who bought a large estate to the south of the estuary of the Dee, being fully convinced that high groynes were a mistake, tried the experiment of having small movable groynes, consisting of small stacks driven down into the sand. Boards were also screwed on to the stacks about one foot above the normal level of the sand, and in some places rough hurdles were used. The result of that action had been that his friend had added 1,000 acres to his estate. In his opinion the principle which the author advocated ought to be adopted everywhere in this country. It was a mistake to make large massive masonry dams to break the force of the sea, because if a plus quantity was obtained on one side, a considerably greater minus quantity was obtained on the other. Another important point was the question of the carrying away of the shingle, which was the natural defence of the shore. How any reasonable body of people could be induced to allow shingle to be carried away from a shore line was more than he could ever understand. Nevertheless, it was going on almost everywhere; it ought to be stopped. In some cases the ignorance was so crass on the question of coast defence, that he had known cases where blocks on the foreshores had been actually broken up for the purpose of being used in the construction of a sea wall. The matter was one of enormous national importance; and it had been a very great pleasure to him to listen to a paper in which the ideas on which he and some of his friends had worked during the last twenty-five years, were brought before the public in in such an efficient way.

Mr. W. Whitaker, F.R.S., said it had often been forced on his mind, in the course of many walks along the coast, how difficult it often was for a public body to defend itself. For instance, the southern end of the town of Lowestoft was disappearing, although a great amount of money had been spent on it. The authorities might do what they could within their own border, but unless the work was carried beyond it lost half its value. Piecemeal work was of no use at all, and very often worse than useless. He had seen on the East Coast places where a land owner

had, at great expense, built up a sea-wall which he thought would protect his land, but it did not; the sea got behind it and brought it down. In his opinion there ought to be some central authority to look after the coast, much as the Local Government Board looked after other things; some system must be laid down on which the work could be done. It was extremely difficult in such matters to fight nature, because a little alteration might improve the land owner's particular piece of land, but one did not know what effect it might have a little way off. For that reason the work must be done systematically. There were parts where the land was practically of no value, but it must be remembered that to protect the valuable land it was often necessary to protect land which in itself was not valuable.

Mr. R. F. GRANTHAM said that, having had 30 years experience in the building of groynes and sea-walls on different parts of the coast, he agreed with Professor Dawkins, that low groynes were the correct form for preserving shingle on the shore. Groynes were not intended as wave-breakers, but to collect shingle or sand, which were the natural protection of the coast line His experience went further than that, because he found it perfectly possible to defend a long line of shore solely by means of groynes without any sea-wall, any form of breastwork, or timber work. He knew the Yorkshire coast well; and in his opinion the whole of that coast from Bridlington down to the Spurn could be very well defended by groynes, without sea-walls or breastwork. It was a question of time and great patience, but it could be done. He did not agree with the author where he said it was the rule that groynes should be run out at right angles. His experience was to give them a definite angle to the shore away from the prevalent wind. He had observed, from years of experience, that a more even distribution of the shingle on the two sides could be obtained in that way than by using a right-angle groyne. He had seen illustrations of that over and over again, where great accumulations were obtained on the shore on the windward side, and a great scour on the leeward side, which was due to a great extent to the groynes being placed at right angles to the shore. In the building of sea-walls he hada dopted a curved profile, which answered well; but if he were to build more he should be very much inclined, if he had money enough, to construct them on the section adopted at Margate, which was an admirable one, for the reason that, as the sea broke against the wall, the steps broke up the wave as it came up the wall, so that there was not the heavy recoil or splash over the top of the wall which there was when it was built, either with a slope or a curved face. He did not agree with the author's suggestion that a Commission should be appointed, and the country divided up into districts, for the reason that there were at least twenty-one Commissions of Sewers already in existence, which controlled large areas of the country, and it would be a difficult matter to sweep them away. They had under their control more than half a million acres of land, and had not only their sea frontages to take care of but the drainage in their districts, which depended on a number of sluices inserted in the sea-walls. He, therefore, thought it would be extremely difficult to take away the powers of those bodies, and put them into the hands of a general body. The great need was that some body should be established to control the shore, who would have the right of vetoing or amending any proposal which might be made for the building of a groyne or sea-wall.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his instructive and interesting paper, said that Mr. Carey had brought the very important subject of the prevention of coast erosion into review under three aspects, the Physical, the Engineering, and National. The National, though last, was not by any means the least; and it certainly behoved England as a nation to take the matter into account. Other nations were very much further ahead in that respect than England, just as, for instance, in the question of Forestry. Unless something was done, thousands of useful acres of land would go into the sea year by year. From the limited experience he had obtained in charge of the coast line under the War Department, he thought the whole question was summed up by the word "shingle." Once a coast was denuded of its shingle, and its treacherous boulder clay laid bare, one might say that they were thoroughly well in the mud, and there was no chance of getting out of it. The more modern expedient of dumping shingle seemed to be the only possible remedy under the circumstances. The general consensus of opinion was that the low groyne was the right thing; and, so, far as he knew, that was correct, provided the surface of the groyne conformed to the configuration of the foreshore, and, as the author had pointed out, the adding of further boards as the shingle accrued. There was no doubt there was very considerable difficulty in dealing with such an extensive coast as England possessed, and it was not to be supposed, as Mr. Grantham had pointed out, that the matter could be lightly undertaken without trespassing on somebody's rights. But something undoubtedly might be done, although he thought anything in the nature of complete Government control or State aid was very far off. The strict prohibition of the removal of shingle might very well be enacted, and also the putting into motion of some machinery whereby a neighbour was not allowed to carry out a system of groynes, according to his own peculiar ideas, which would cause considerable destruction to the land of his neighbour. In his own experience he had found that the evil could be reduced, to a certain extent, by tailing off the groynes as a neighbour's territory was approached, *i.e.*, not keeping up the same length and ending up abruptly, but tailing off, which prevented the sea making a dead set

against any particular part of the coast which was unprotected.

The vote of thanks was then put, and carried unanimously.

Mr. CAREY, in reply, said that Lord Montagu's remarks were extremely valuable, and, as far as he knew, entirely novel, the points he had raised being worthy of the most careful and exhaustive study, more especially the botanical side of the question. There was a very wide divergence of opinion as to whether the travel of shingle and the movement of the flood tide were necessarily connected and collateral, and the point had been fought a great many times; but it opened up too wide a subject for discussion on the present occasion. The remarks his lordship had made with regard to seaweed were also of a most important character. Professor Dawkins's remarks recalled to his mind several discussions he had years ago with his friend Mr. Henry Willett, and he entirely endorsed the very shrewd observations which that gentleman generally made in support of his argument. Reference had been made to the reckless way in which shingle was often removed from the shore. At Mundesley, on the Norfolk coast, there was a continual stream of carts day after day carrying shingle to the top of the cliff, where it was used for road metalling. He quite agreed with Mr. Grantham, that it was impossible to lay down a general rule that groynes should always be at right angles to the shore. Each individual case must be studied; but, broadly speaking, it seemed to him that general experience tended in that direction at any rate. With regard to the 21 bodies of Commissioners of Sewers which Mr. Grantham mentioned, he (Mr. Carey) acted for several of them; and therefore if the proposed Commission came into force Othello's occupation would be, to some extent, gone. At the same time, he thought it was the right thing that the matter should be taken in hand by some central authority. It seemed to him the negative powers which Mr. Grantham suggested would be extremely doubtful. All active interference would still be left to the local bodies, and in his opinion they never could or would work effectively.

Mr. H. J. BAKEWELL writes:—In accordance with the suggestion of the Chairman last night, I would like to state that my experience of groyne work, extending over twenty years, has shown that, so far as retention of shingle is concerned, both high and low groynes, properly planned, are, in most cases, equally effective. High groynes permit of being placed wider apart, but must be made proportionately strong, while the low groynes may be of lighter construction but nearer together. Where it can be arranged, the latter is to be preferred as forming a more uniform beach line. The cost may be considered in favour of the low groyne when carried out on a large scale. Terminal groynes, whether high or low, should be double, as the scour on the leeward side is greater and the strain intensified by the absence of further barrier to sustain the beach, and therefore a much stronger structure is necessary. The double groyne is, moreover, useful, inasmuch as it can be formed into a trap to regain shingle that may be swept back by change of wind and current. I may say that I have found this beneficial in my experience.

THE ARTIFICIAL SILK INDUSTRY IN FRANCE.

According to a recent report from Lyons several manufacturers in and around the city are employing artificial silk, or *soie de chardonnet*, as it is called, in the manufacture of light goods for summer wear, and it has been stated by one of the French companies engaged in this business that the exports to the United Kingdom, Belgium, and the United States, are holding their own, while the shipments to other countries show an increase. Artificial silk is being used in some factories in combination with the natural silk. In *mousseline de soie* the warp is made of natural silk, and the woof of chardonnet. In some houses a thread of chardonnet and a thread of natural silk are passed alternately on two different shuttles. The American Consul at Lyons says a great difficulty that the manufacturers of goods from artificial silk have to contend with is, that the stuff cannot stand exposure to dampness or the least rain. He is informed, however, that in bleaching the artificial with the natural article the difficulty is very largely overcome. It is also said that by combining a thread of chardonnet with a thread of natural silk the former adds a very desirable brilliancy to the finished material, which adds to its value as used in laces, passementerie, mousselines, ribbons, gauzes, and anything used in trimmings. A new article called "chifolineis," a species of goods manufactured from artificial silk, is used very largely in the trimmings of ladies' hats. All the milliners in France use it, and one firm in Lyons has orders for it for six months ahead. The artificial silk works at Besançon, which had dismissed many of their *employés* on account of a period of depresession, have recently been working on full time, and giving employment to nearly two thousand men. They export their goods to all the countries of Europe except Germany, where an arrangement has been entered into with a German company, by which the French company will not invade their market. The stock in the French company, which had fallen very low, has been marked by a steady rise. It is reported in Lyons that an effort to establish a mill in the United States for the manufacture of chardonnet silk has been adandoned on account of the high wages paid to American workmen. The manufacturers in Lyons say that it is more profitable to pay the 30 per cent. duty than to put up works there and pay the high wages to American workmen.

HOME INDUSTRIES.

The Tin Plate Trade.—This trade continues in a remarkably prosperous condition. At the close of 1906 there were 381 tin-plate mills, and 60 sheet mills working, and 22,000 people employed in them. At the present time there are 450 mills in operation. The Board of Trade returns show that the export of tinned plates for the three months ended March last amounted to 101,332 tons, as compared with 91,771 tons in the corresponding period of 1906, an increase of 10·4 per cent., with practically the same percentage of increase in value. The shipment of black plates for the same months exceeded those for the first three months of last year by 18 per cent., the increase in value being over 19 per cent. The output of tin plates in 1906 was the largest on record, with the one exception of 1891, when the American merchants were stocking their warehouses in expectation of the McKinley tariff. Last year the shipments of tin and terne plates (including black plates), amounted to 8,822,240 cwt., valued at over £5,500,000 sterling, an increase of 329,580 cwt. over those of 1905. This year the increase continues, and there is every prospect of the output of 1907 exceeding that of 1891. Each month this year has seen an increase in the number of tin plate and steel mills working. In spite of the high price of tin, and the consequent dearness of tin plates—last year's prices of tin plates ranged from 13s. to 15s. 3d. per box, f.o.b., the present quotation is 14s. 10½d.—orders continue plentiful, and assuming that tin remains under £200, the increased production of the first three months of the year is pretty certain to continue throughout it. Owing to the operation of the rebate of 99 per cent. Great Britain has been able to retain most of its tin-plate trade with the United States, but it is diminishing. In 1904 it was 71,862 tons, in 1905 63,050 tons, in 1906 only 61,518 tons. The trade with the Colonies remains practically stationary, with the exception of Canada, which took only 19,986 tons in 1906, as against 21,238 tons in 1905, the explanation being local competition and that of the United States. It may be noted that the quantities exported to these two countries in the first three months of 1907 show an increase of nearly 50 per cent. on that of last year, bnt it would be unwise to assume a continuance of this increase, and, indeed, Welsh manufacturers anticipate the eventual loss of the American and Canadian trade. Fortunately the market is widening in other countries. Europe is increasing her demand for the product. Owing to the devastation of the Baku and other South Russian oil centres by rioters last year, Russia took only 4,849 tons of tin plates in 1906, as against 31,272 in 1902, and of black plates 14,000, as against 31,000, but imports are now increasing again, the exports of tin plates to Russia for the past three months being 2,141 tons, as against 219 tons in the first quarter of 1906. With the exception of Russia, the exports to the leading European markets show substantial increase.

The Frozen Meat Trade.—The dependence of the United Kingdom upon foreign countries for its corn supplies is overwhelming. At the present time less than one loaf of every five consumed is made of home-grown wheat. But until now dependence upon the foreigner for meat supplies has not been in anything like the same proportion. This disparity is, however, diminishing. Ten years ago the imported beef, mutton, and lamb amounted to 32 per cent. of the consumption. To-day, if figures compiled by Messrs. Waddel and Co. are correct, as no doubt they are, of the total consumption in the United Kingdom frozen meats represent 17 per cent., chilled beef 9 per cent., imported cattle and sheep 11 per cent., so that 37 per cent. of the meat eaten in the United Kingdom is foreign. In 1903 the British consumer paid £10,123,592 for foreign beef, and £7,932,390 for foreign mutton; in 1906 the figures were £11,115,312 and £7,781,497; but, although the value of the frozen mutton consumed was somewhat less in 1906 than 1903, the quantity imported had increased from 4,065,776 cwt. to 4,137,132 cwt. And so with beef, the increase being from 4,805,813 cwt. in 1903 to 5,986,793 cwt. in 1906, The Argentine continues to be the chief source of supply. The exposure of Chicago methods prejudiced foreign meats, and for the moment checked consumption, but the effect was only temporary, and the popularity of Australian, New Zealand, and the River Plate meat was never greater than now. Next to the Argentine comes New Zealand as the source of our frozen meat supply. Australia was of course adversely affected by the great drought, but exports may be expected to largely increase now that the flocks and herds are once more rapidly growing. In the Argentine, the province of Buenos Ayres is suffering from drought, and meat exports will be affected this year. The meat trade of New Zealand with the United Kingdom shows uninterrupted growth. The home supply remains almost stationary, and but for colonial and foreign meats consumption must have been greatly restricted unless the public were prepared to pay much higher prices. It seems strange that the home supply does not increase, having regard not only to the steadily increasing population, but to the growing proportion of it which consumes meat in appreciable quantity.

Compulsory Arbitration.—The working of the Arbitration Courts in Australia and New Zealand has been watched with keen interest in this and other countries by those who desire better relations between capital and labour, and at first very favourable reports were received, but it would seem that the public directly concerned are beginning to regard them less hopefully. The Melbourne correspondent of the *Economist*, in a letter which appears in that journal of April 27, makes statements deserving of attention coming as they do from a very competent observer. He says the Arbitration Courts appear to be losing the power to command the allegiance of *employés*. In New Zealand the slaughtermen in several places struck for

higher wages than had been allowed them by the Arbitration Court. The Court fined a number of the men, but the strike was persisted in until the employers agreed to the demands of the men. The fines were then paid, but the fact remains that the award of the Arbitration Court had been ignored and a settlement made in defiance of it. Again, in Western Australia, in a dispute between saw mill owners and their workmen, the Arbitration Court adjudicated, but the men refuse to accept the terms, and in March were still on strike, "not against the employers but against the Arbitration award," to quote the general secretary of the Amalgamated Saw Millers' Union. Then there was the dispute between the colliery proprietors and miners north of Sydney. The Union decided not to have recourse to the Arbitration Court but to disregard its previous award, and after some weeks a settlement was arrived at between employers and employed. The powers of the New South Wales Arbitration Court have been much restricted by a judgment of the Supreme Court. In giving judgment the Chief Justice said, "The Arbitration Court was a Court of very limited jurisdiction. It was thought by the framer of the Act that this Act would give the Court a very extended and very extensive jurisdiction—that it would be an Act to set at rest all industrial disputes, and that strikes would cease. Unfortunately it was found by experience that the Arbitration Act had conferred upon the Arbitration Court a very limited jurisdiction indeed, and in place of putting an end to strikes the fact was that strikes were as prevalent as ever they were, if not more so, especially in certain industries. . . . . I am not surprised, to a certain extent, that the Court should struggle to have some jurisdiction. Its jurisdiction seems to be waning. Almost every case which comes before us is one in which we have to decide this question of jurisdiction. In some of these cases it would have been very well, possibly, if the Court had had the jurisdiction. In others it was very fortunate that it had not, because it was a distinct interference with the liberty of the subject." This does not look as if the principle of compulsory arbitration is making much headway. Much must depend upon the character of the *personnel* of the Judges who administer the law. The Judges can hardly be expected to display equal aptitude in measuring the importance and in assessing the value of trade conditions. They lack the knowledge only to be got from experience. "The best agreements made in Australia," says the correspondent already quoted, "are those that have resulted from Conferences between employers and employed, who know what they are discussing far better than outsiders can possibly affect to know." That of course is true, but then if employers and employed were always willing to discuss matters without passion, and to agree to concessions on this side and that suggested by equity, and supported by experience, there would have been no thought of giving a Court of Law power to decree a settlement.

Absence of Books.—According to the Registrar of the London Bankruptcy Court, "the absence of books has become quite a disease in his Court," especially in the case of foreigners. It is a little surprising that there is no statutory obligation upon traders in the United Kingdom to keep books. The Companies' Acts do not require books to be kept. The practice abroad is quite different. In Germany every trader must prepare an inventory of stock and a balance-sheet when commencing business and at the end of each financial year. The legal code enforcing this, which came into operation in 1900, gives detailed regulations for the books and accounts to be used in different trades and industries.

Hematite Iron Ore. — Attention was recently directed in these Notes to the supplies of hematite iron ore from the mines of the North-West of England, and to the efforts to find fresh deposits. In this there has only been partial success; but discoveries of important bodies of ore have been made, the most important finds lately made being at Lindal and at Ronhead. It is known that very large deposits of ore exist at Hodbarrow and at Ronhead, deposits which will take many years to work out. The deposits are believed to extend beneath the estuary of the Duddon, from Cumberland on the one side to Lancashire on the other. An effort has been made by the local and county authorities to come to an understanding as to the boundary line between the two counties, an important matter, seeing that iron mines are rated and contribute a large sum towards local expenditure. No agreement has as yet been arrived at. It looks as if the future supply of iron ore from the North-West of England will be mainly derived from this district.

The Cotton Industry.—Whilst the weaving from bought yarn department of the cotton trade is suffering in its profits from high priced twist and weft, the spinning part of the trade continues to earn large profits. Mr. Tattersall has given details of twenty concerns which issue particulars of profits and they work out at 30·44 per cent. per annum. The outlook continues on the whole encouraging, and it may be noted that the cotton industry on the Continent is in an exceptionally active condition. Even Russia is very busy, both spinners and manufacturers having for some months past experienced a brisk demand. In Germany the condition of the industry is highly satisfactory and the prosperity of the mills unprecedented. Stocks of yarns and goods are small, and a feature is that more East India cotton has been used this year. In Austria and Hungary during the past year there has been an increase of 50,000 spindles and 20,000 looms, mostly in Hungary. There are no stocks of yarns or goods, and prompt delivery commands a premium. Switzerland is very active; in France several mills have begun night work; in Holland looms have increased faster than spindles; in Belgium the outlook is encouraging; and in Italy the mills are working at their full capacity at profitable rates.

GENERAL NOTES.

NICKEL IN NEW CALEDONIA.—In his report on the trade of New Caledonia for 1906, Mr. Acting-Consul Manning refers to the production of nickel ore. Last year this production was 5,399 tons more than in 1905, but the value appears less, the reason being that in 1905 the ore for statistical purposes was valued at 45 francs per ton, and now is calculated at 30 francs only. Nickel ore could be produced much cheaper if the demand was greater, and sales of ore sure, as mines once opened would then be able to carry on, in place of which the rule has been that after some two or three years producers have had to throw all their men out of work, and wait for a contract before proceeding again, a system that would strangle any industry. The production for the past year was 57,367 metric tons, as against 51,374 metric tons in 1905. This industry in New Caledonia is at present virtually in the hands of one firm.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MAY 8.—"The Production of Coke and its Application in Domestic Fires." By PAUL SCHLICHT. CORBET WOODALL will preside.

MAY 15.—"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department. CHARLES EDWARD HENRY HOBHOUSE, M.P., Under Secretary of State for India, will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 6...Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Ernest Romney Matthews, "Waterworks Construction in America."

Chemical industry (London Section), at the Chemical Society's Rooms, Burlington-house, W., 8 p.m. Mr. O. Guttmann, "The Works Chemist as Engineer."

Surveyors, 12, Great George-street, S.W., 6½ p.m. Annual Meeting. (Junior Section) 7½ p.m. Mr. G. T. Loban, "The Case of the British Inland Waterways."

British Architects, 9, Conduit-street, W., 8 p.m. Annual General Meeting.

TUESDAY, MAY 7...Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. Stirling, "Stimulation, Luminous and Chemical." (Lecture III.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

Pathological, 20, Hanover-square, W., 8½ p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. J. Watson, "Dry Collodion Plates with Preservatives."

Zoological, 3, Hanover-square, W., 8½ p.m.

East India Association, Caxton-hall, Westminster, S.W., 4 p.m. Sir Roper Lethbridge, "Imperial Preference, Cobdenism, or Swadeshi—Which is Best for India?"

WEDNESDAY, MAY 8...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Mr. P. Schlict, "The Production of Coke and its Application in Domestic Fires."

Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

Royal Literary Fund, 7, Adelphi-terrace, W.C., 3 p.m.

THURSDAY, MAY 9....Iron and Steel Institution, 25, Great George-street, S.W., 10½ a.m. Annual Meeting. Papers to be read:—1. Prof. W. A. Bone and Mr. R. V. Wheeler, "The Use of Steam in Gas Producer Practice." 2. Messrs. H. Brearley and F. Colin Moorwood, "Sentinel Pyrometers and their Application to the Heat Treatment of Tool Steel." 3. Mr. A. J. Capron, "Induced Draught with Hot-air Economisers for Steel Works and Blast Furnace Boilers." 4. Mr. F. W. Harboard, "The Influence of Process of Manufacture on some of the Properties of Steel." 5. Mr. Joseph Henderson, "The Distribution of Sulphur in Metal Ingot Moulds." 6. Mr. Arthur W. Richards, "Steel Making from High Silicon Phosphoric Pig Iron by the Basic Bessemer Process." 7. Mr. Arthur W. Richards, "Steel Making from Pig Iron Containing Chromium, Nickel, and Cobalt." 8. Mr. D. Selby-Bigge, "Electrically-Driven Reversing Rolling Mills." 9. Mr. C. E. Stromeyer, "The Ageing of Mild Steel." 10. Mr Thomas Swinden, "Carbon-Tungsten Steels." 11. "The Nomenclature of Iron and Steel" (Report of Committee of the International Association for Testing Materials).

Royal, Burlington-house, W., 4½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. F. Newall, "Spectroscopic Phenomena in Stars—I. Chemistry."

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m.

Mathematical, 22, Albemarle-street, W., 5½ p.m.

Book-keepers', Cannon-street Hotel, E.C., 7 p.m. Mr. T. Mackworth Lucas, "The Elements of Bankruptcy Procedure."

FRIDAY, MAY 10 .Women Journalists (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m.

Iron and Steel Institute, 25, Great George-street, S.W., 10½ a.m. Annual Meeting continued.

Royal Institution, Albemarle-street, W., 9 p.m. Signor Com. Giacomo Boni, "Recent Excavations on the Forum Romanum and the Forum Ulpium."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Velasquez."

Astronomical, Burlington-house, W., 5 p.m.

Clinical, 20, Hanover-square, W., 8½ p.m.

Physical, Physics Laboratory of the Royal College of Science, Imperial Institute-road, South Kensington, S.W., 8 p.m. Dr. T. C. Potter, "Stereoscopy with long Base line, illustrated on the Screen."

SATURDAY, MAY 11...Royal Institution, Albemarle-street, W., 3 p.m. Prof. W. C. McIntosh, "Scientific Work in the Sea Fisheries." (Lecture II.)

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FRIDAY, MAY 10, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

WEDNESDAY, MAY 15, 8 p.m. (Ordinary Meeting.) Dr. HERBERT W. G. MACLEOD, "Trypanosomiasis or Sleeping Sickness."

Further details of the Society's meetings will be found at the end of this number.

PROCEEDINGS OF THE SOCIETY.

COLONIAL SECTION.

Tuesday afternoon, April 23; the HON. ALFRED DEAKIN, Prime Minister of the Commonwealth of Australia, in the chair.

The CHAIRMAN, in introducing the author of the paper, said that Dr. Hackett was a Member of the Legislative Council of Western Australia, and for many years had been a prominent figure in the national politics of the Commonwealth of Australia.

The paper read was—

SOCIAL AND ECONOMIC CONDITIONS IN AUSTRALIA.

By HON. JOHN WINTHROP HACKETT, LL.D.

The heading of my address this afternoon is the social and economical development of Australia. A large subject, but I hope my hearers may be reassured when I say that in the first place I desire not to repeat anything I have said in a paper I have just read elsewhere, and next with one exception I propose to confine myself to a few typical considerations. The exception consists of some statistics which however necessary for your information usually convey educational nourishment in the direct and most trying of forms. I trust they will not weary you, but Australia has just now so many critics, and seems in so many eyes to occupy the position of a suspect that the moment appears particularly fitting to give a few of the latest economic facts in regard to the rise of a colony, which, if we consider the date of its foundation, its earlier drawbacks, its geographical situation, and then look at its position to-day, one can say without hesitation presents the most marvellous example of successful colonisation recorded in any age and for any people. Perhaps this remark will prepare you for my statement that I am going to say little but what is good of the Commonwealth. I must add a word as to my obligations to Mr. Coghlan, the Agent-General for New South Wales, whose office has given me material help in collecting the statistical facts which I shall proceed to put before you.

Too many people, probably, overlook the fact that the Australian Commonwealth comprises more than 35 per cent. of the territory constituting the British Empire, and that with 97 per cent. of its inhabitants of English, Scotch, and Irish descent, it is the most purely British portion of the Empire outside the Motherland. Moreover, it has to be remembered that by far the great majority of those who emigrated to Australia were of a strenuous and hardy type, seeking scope for their energy and enterprise, which forms some explanation of the gigantic advances made in her settlement and in her industrial development.

POPULATION.

At the close of 1861 the population of Australia and Tasmania, exclusive of aborigines, was 1,165,183. In 1891 the population had increased to 3,240,531, and during the greater part of this period the country gained

largely by immigration. From 1891 to 1905 Australia gained but little from immigration, the growth of population to 4,052,474 persons being due principally to excess of births over deaths.

When the statistics concerning population and internal and external trade are compared it will be noted with interest that the years of the greatest prosperity in Australia have also been those when the country received the largest accession of population from abroad; and although, as Mr. Coghlan states, it cannot be said that the influx of population brought prosperity, it may fairly be said that the stream of immigration, induced by the prosperity of the Colonies, tended to keep alive and stimulate the conditions without which national progress on any large scale would have been impossible.

Our present population per square mile of territory is barely 1·50; several of the States have not yet reached the stage of one person to the square mile. In the most densely poputated State, Victoria, the population is still under 14 souls to the square mile.

Conditions of Life.

The excess of births over deaths is much greater than in the United Kingdom, the births totalling about 19 per thousand as compared with 12 per thousand in Great Britain, and the European average of barely 10 per thousand. The birth-rate for 1905 was 26·06 per thousand; the marriage-rate 7·20 per thousand, and the death-rate 10·81 per thousand.

Distribution of Population.

Except during the "fifties," when gold-seeking engaged the attention of practically the whole of the population of Australia, there has always been a tendency, and a growing one, for a large congregation of the population of the respective Colonies in cities and towns. At the beginning of 1906 the population of the capital cities was:—

Sydney....	529,600	of a total of	1,491,763
Melbourne.	515,350	,,	1,218,571
Brisbane ..	129,736	,,	528,048
Adelaide ..	173,235	,,	378,208
Perth .... (Including Fremantle)	80,000	,,	254,779
Hobart....	34,989	,,	181,105

The burden of production from the three principal primary industries—pastoral, mining and agricultural, valued at £96,500,000 per annum—is borne by about 600,000 persons, of whom some 70,000 are engaged in pastoral pursuits, 120,000 in mining, and 305,000 in agriculture. In the manufacturing industries about 275,000 persons are engaged, and the value of production in 1906 was £30,000,000; the total production from primary industries and manufactures for the year being nearly £140,000,000.

Compared with population, this amount of production is not exceeded, or even closely approached, by any country; and in regard to total value is surpassed only by seven States, the United Kingdom, France, Germany, Austria, Russia, Italy, and by the United States of America. And the return for the last fifty years from our wool and minerals alone amounts to almost double the National Debt of the United Kingdom.

Shipping and Trade.

The total movement of shipping—entered and cleared—from and to Commonwealth ports during 1906 was 30,406,049 tons, or 7·55 tons per head of the population.

In 1861 the tonnage was 2,425,148, or 2·10 per head of population.

In 1891 the tonnage was 12,235,213, or 5·07 per head of population.

In 1891 the tonnage was 26,198,899, or 6·89 per head of population,

compared with a total tonnage of 120,000,000 tons, or 4 per head of population in the United Kingdom.

The interstate shipping traffic of the Commonwealth amounted in 1905 to just under 23,000,000 tons. In 1861 the intercolonial tonnage was well under 2,000,000 per annum. In 1881 it was little more than 5,000,000 of tons, and in 1891 barely reached 11,000,000 of tons.

The exports to countries outside the Commonwealth in 1905 was £56,841,035, and the imports from countries outside the Commonwealth £38,346,731, showing an excess of exports of £18,494,304.

The total trade—imports and exports, interstate and external—of the Commonwealth in 1906 came to no less a sum than £170,000,000, about £42 per head of population, compared with a trade of about £20 per head in the United Kingdom.

During the last fifty years the pastoral industry has maintained steadfastly its supremacy as the chief source of Australian wealth.

	Value of Exports. £
1861	5,105,721
1871	11,882,736
1881	13,396,207
1891	20,461,877
1901	15,370,321
1905	19,814,924
1906	22,669,803

the value of the wool clips to date being £670,000,000.

In 1861 the sheep numbered	20,980,123
„ 1871 „ „	40,072,955
„ 1881 „ „	65,078,341
„ 1891 „ „	106,419,751
„ 1901 „ „	72,208,736
„ 1905 „ „	74,403,704

and at present over 80,000,000 sheep, chiefly of merino breed, are depastured on the natural grasses, and owing to the improvement of the fleece in quality and weight, the monetary return per sheep is now greatly increased. The total value of pastoral property, including land devoted to grazing, is about £230,000,000, and the value of stock alone is considerably in excess of £100,000,000. Since 1851 the output of wool alone has reached the total value of £670,000,000. Of cattle there were 8,525,295 in Australia in 1905, and 1,673,805 horses. In the dairy industry, which is expanding rapidly, 1,645,718 cows were employed in 1905. Of 140,868,726 lb. of butter made in that year 50,000,000 lb., valued at £2,447,134, were exported. In 1906, 75,803,862 lb. of butter valued at £3,242,174 were exported. The exports of frozen beef and mutton and sheepskins for 1905 were £2,919,018, and for 1906 exceeded £3,000,000. Timber, chiefly hardwoods, is now exported in yearly increasing quantities, and in 1905 £1,036,183 worth was exported, while the figures for 1906 show a considerable increase.

Coming to the area under cultivation, up to the present time about ten millions of acres, or half of one per cent. of the total area of the Commonwealth has been devoted to the plough. As will be seen by the following figures the expansion of cultivation has been more than a hundredfold during the last 25 years:—

Total area under crop.	Acres.
1861	1,269,042
1871	2,345,922
1881	4,489,607
1891	5,365,685
1900	8,813,666
1905	9,433,455
1906 .. approximate	10,000,000

It has been in the cultivation of wheat that the greatest advance has been made during the past 15 years, the area under this crop having been increased practically a hundred per cent., and at present over three-fifths, or 6,122,746 acres of the total of the cultivated land in Australia is devoted to the staple cereal; the return for 1905-6 being 68,520,772 bushels. Ten years ago Australia was an importer of breadstuffs; now the exports of wheat and flour, principally to the United Kingdom, are valued at over £6,130,000 per annum. In all the States the area cropped with wheat represents but an infinitesimal fraction of the area upon which this crop can be successfully grown; and as we approach a higher standard of farming, it may be expected that the returns from the land already cropped will be greatly increased, even if the present annual expansion of acreage be not maintained. From a commercial point of view, Australian wheat has won a topmost place in the British markets, and generally realises about 2s. per quarter more than any other wheat. The Australian farmer has, moreover, at his command vast areas of soil, within the regions of reliable and adequate rainfall, most effective and economical cultural and harvesting machinery, and 15,000 miles of State railways to carry his grain to market, and all combined with cheap and rapid transport by sea.

The acreage devoted to other crops for which respective regions of Australia are pre-eminently adapted is:—

	1905-6. Acres.
Maize	314,901
Oats (for grain and fodder)	466,567
Barley and other grains	135,798
Potatoes	121,762
Sugar cane	155,912
Hay (chiefly wheaten)	1,574,382
Vines	64,357
Orchards and minor crops	477,030

Although in general farm crops other than wheat no very considerable advance would appear to have been made during the past ten years, the prosperous development of the dairy industry has resulted in an enormous expansion of the areas of artificial pasturage. This is an important fact. In New South Wales alone almost a million acres have been already sown to grasses and crops of this description, and in Victoria even a greater area. The addition of these pastures to the natural sources of fodder, combined with the private and public systems of water conservation which

are being continually extended, will do much to safeguard the stability of the pastoral industries. The value of agricultural production in 1905-6 was £21,000,000.

Mineral Wealth.

The total mineral production of Australia to the end of 1905 was £633,737,302, of which

Gold represents	£460,397,288
Silver and silver lead	45,068,960
Copper	42,660,466
Tin	22,555,872
Coals	53,909,501
Other minerals, comprising practically all known minerals	9,145,215

The annual production is nearly £25,000,000, as under:—

Gold	£15 559,641
Silver and silver lead	2,861,604
Copper	2,274,766
Tin	1,106,208
Coal	2,337,504
Other minerals	882,612

Revenue.

The revenue of the Governments of the Commonwealth and the respective States exceeds £35,000,000 per annum, which is about a third that of the United Kingdom with a population ten times as numerous. In Australia, however, practically all the railways belong to the State, and the revenue from this source is nearly fourteen millions per annum.

The total revenue collected by the respective Colonies prior to federation was:—

1861	£5,464,188
1871	7,866,534
1881	16,591,547
1890-1	25,454,128
Since federation:—	
1900-1	£29,535,943
1905-6	35,760,520

If we take the sources of revenue for 1905-6, we find we receive from taxation—

Customs and excise	£8,999,485*
Other	3,445,112
Railways and tramways	13,624,347
Posts and telegraphs	2,824,348
Public lands	3,229,129
Other sources	3,628,099

* Of this the surplus above requirements for Federal services is returned to the respective States, *pro rata*, as under:—

New South Wales	£2,742,770
Victoria	2,097,119
Queensland	857,048
South Australia	539,879
Northern Territory	21,632
Western Australia	872,992
Tasmania	256,390
	£7,387,830

The expenditure, exclusive of loan expenditure, totals for—

1861	£5,744,903
1881	15,232,017
1890-1	26,790,034
1900-1	30,164,414
1905-6	29,731,885

Public Debt.

The greater portion of the public debt of the respective States of the Commonwealth has been incurred for the construction of railways and other revenue-yielding works. The following shows the use to which the borrowed money was put:—

Railways and tramways	£139,293,173
Telegraphs and telephones	3,771,663
Water supply and sewerage	30,266,977
Harbours, rivers and navigation public works, buildings, roads, and bridges	42,221,779
Other services	10,869,755
	£226,423,347

The annual interest (average 3·62 per cent.) and charges upon the public debt amount to £9,303,000, while the net revenue from works constructed from loan funds amounts to £6,554,000, leaving a net liability of £2,749,000 per annum.

The increase of Australian indebtedness may be traced in the following figures:—

1861	£11,300,940
1871	30,139,880
1881	66,306,471
1891	155,117,773
1901	204,952,075
1905-6	238,427,821
Total loan expenditure per head of population	£55 16 2
New Zealand	70 16 4

Banks.

In 1905-6 the deposits in the savings banks amounted to £38,789,889, and in ordinary banks to £110,905,269. The wide margin between the high wages earned by Australians and the comparatively low cost of living is strikingly reflected in the ever-growing ranks of depositors in the savings banks:—

Year.	Depositors.	Credit.
1871	100,799	£3,220,806
1881	250,070	7,893,464
1891	614,741	15,536,592
1900-1	950,079	30,869,591
1905-6	1,174,326	38,789,889

The average amount of £33 per depositor is not exceeded in any country, and the total

accumulation for the whole community stands unparalleled.

When it is remembered that in Australia a large majority of the working classes are members of some sort of provident institution, and that the proportion of wage-earners who possess houses and land is greater than is the case in any other portion of the world, it must be admitted there are grounds for holding that the prosperity of Australia seems as firmly based as it is widespread.

Railways.

Compared with population Australia is even better served with railways than the United States. There are now 15,078 miles open to traffic, and new lines are continually being added to the system of the respective States. The length of line is equal to about one mile for every 220 square miles of territory, and to every 275 inhabitants.

The growth of the railway mileage in Australia has been as follows:—1861, 243 miles; 1871, 1,030 miles; 1881, 4,192 miles; 1881, 4,192 miles; 1891-2, 10,394 miles; 1901-2, 13,821 miles; 1905-6, 15,078 miles.

The gross earnings of the Australian railways for 1905-6 were £12,807,787; working expenses, £7,540,535; leaving net earnings, £5,267,252.

The interest returned on the capital of £135,427,222 invested in Australian State railways is thus 3·89 per cent. Already the net earnings per train mile in Australia (2s. 11·37d.) compare favourably with the earnings of railways in densely populated countries, and as the Australian railroads serve millions of acres of territory not yet utilised to a fraction of its productive capacity, and are probably hardly equalled for the durability of materials used in construction of the permanent way, they form an asset involving low maintenance expenditure, one that can be relied upon to return an ever increasing revenue as the country becomes more densely settled and worked.

Postal Facilities.

The postal facilities of the Commonwealth are largely availed of. In 1905 the number of letters and postcards transmitted reached 322,774,634, being at the rate of 80·16 per head of population. When the enormous oversea and interstate trade is taken into consideration, it can readily be seen that the bulk of these letters constitute commercial correspondence. The growth of postal business may be seen by the following figures:—

1861....	13,564,265 or 11·75	per head of population.
1871....	26,040,035 or 15·53	,, ,,
1881....	72,278,616 or 31·64	,, ,,
1891....	168,907,355 or 52·70	,, ,,
1901....	239,560,717 or 62·98	,, ,,
1905.. .	322,774,634 or 80·16	,, ,,

The transmission of newspapers by post has increased in corresponding ratio, the figures for the closing year of respective decades, being:—1861, 10,211,469; 1871, 14,173,941; 1881, 41,486,973; 1891, 93,067,560; 1901, 117,584,798; 1905, 129,414,198.

In the matter of telegraphic communication, Australia is excellently served. In all there are at present 45,228 miles of lines throughout the States, and submarine cable communication with the Mother Country, New Zealand, and Canada. In 1861 there were less than 3,000 miles of line; 1871, 11,518; 1881, 25,604; 1891, 39,176; 1901, 45,108; 1905, 45,228. Since federation, the telegraph service in conjunction with the postal arrangements have come under the control of the Federal authorities, and telegraphic rates throughout the Commonwealth approximate those of the United Kingdom.

Education.

The youth of Australia enjoy educational facilities that compare well with those of any country. Illiteracy among the native-born Australians is practically a thing of the past, and adults unable to read or write are chiefly natives of other lands. Of State schools maintained from the consolidated revenue, there are 7,300, with 15,544 highly trained teachers. The net enrolment of scholars was 616,080 for 1905. In addition there are numerous private day and boarding schools which maintain a high standard, State technical schools and colleges, and nearly all the States enjoy the advantages of a university.

With the growth of population and the spread of education in Australia, serious crime, as evidenced by convictions at the Superior Courts, has greatly diminished, and so far as crimes of violence against the person are concerned, the Commonwealth enjoys an enviable reputation, the very small proportion of inhabitants of homicidal propensities amounting to statistical insignificance.

Some General Remarks.

It is time, however, to leave figures and take a glance at one or two special characteristics

of Australia, a country which took its first leap forward so recently as the middle of the last century, and which has succeeded so wonderfully in its efforts to draw level with the best results of older civilisations. What kind of land is this which has done so much in so brief a time? In the first place, in spite of the enormous returns from the soil, much the largest per inhabitant known to economists, let it not be supposed that Australia has travelled so fast and so far because her task was an easy one. We recall with pride the tales of the hardships endured in the work of exploration, of pioneer endeavour, of the gradual subjugation of a wilderness remote from its civilising base and often so refractory. But it may be the future has severer trials in store. Striking as is the record I have just laid before you, I can assure you we recognise that the business of fully adding Australia to the great civilisations of the globe is only in its infancy. We shall have to face many difficulties and allowances must be made for us. Permit me to take a few typical cases, say two physical and one political, the last one, the political labour question, over which Home opinion I fear is much against us. But over all difficulties whatever the Commonwealth is bound at any cost in the end to secure the victory. As to our physical troubles if you look at the map, you will notice that the population and closer settlement of the Commonwealth occupies a more or less narrow fringe of country. Save for a few exceptions this fringe not merely follows the coast but is confined to the extreme south of the island, and even that fringe is broken in the south by a wide stretch of close on one thousand miles of coast where settlement is hardly existent. Further, you will note that the source of the splendid contribution of produce made by Australia to the supplies of the world come from that fringe and from a comparatively slight broadening of it inland. You will notice a vast area probably equal to half of Europe, which is either only partially settled or wholly avoided. In this territory, which is not sterile but merely a wilderness, the families of British descent may be counted only by the score, and those families who expect to make of it a permanent home for themselves and their children are rather to be set down as units. Now, let there be no mistake as to the alertness of our sense of obligation in dealing with this huge vacant dominion. It is for the moment insufficiently utilised but our people well understand that there are going to be no spaces of the earth left waste which can possibly be applied to the service of man. Placed as we are at the very threshold of nations ready to overflow at any moment, with other European Governments looking for openings for expansion, lying in what is likely to be within a measurable historical period, the storm centre of the world's movements, the Commonwealth cannot fail to be alive to its danger no less than its duties. But what we ask is that we shall be given time and opportunity. Do not hurry us unduly; riddles await us in Australia in all directions.

The settlement of this territory may have to wait a little. Many problems, social, political, international, physical, are pressing on us, but that in this continent of experiments, this, one of the greatest of them all will not be ignored, of that our friends in England need have no manner of doubt. But why is this territory, the reproach of the present, left to become possibly the source of quarrel in the future. Why is it left idle? The fact is that throughout two-thirds of her dominion the Commonwealth has to fight or come to terms with two hostile forces unknown to the Motherland, the parching and persistent heats of long summers, and a characteristic scarcity of water. And to Australia has fallen, among all our self-governing communities the task of meeting, and if possible defeating these. Through all this great area these obstacles to the people taking full and beneficial possession of their great island, prevail with a severity well known to those who are still resolved if by any means it can be done, to add this two-thirds of their continent to the productive lands of the globe. It is perfectly possible, nevertheless, that this region may not be found to be adapted to the children of the men whose race has sprung from the chill marsh lands of north-western Europe. But if it be found that this is so the effort will no doubt be made. It is being tried on tentative lines by the present Prime Minister (Mr. Deakin) by drawing settlers from other nationalities. But that those settlers will not be of a coloured race is a foregone conclusion. It will be European like ourselves, and we may hope that if it be found a soil unsuited to British settlers, then from the more sultry lands of Southern Europe emigrants may come to whom the climate may prove more congenial, and who may lay the foundations of prosperous and comfortable homes for themselves and their descendants.

But with the heat there is even a worse enemy,

that of drought, and I dwell on these material obstacles in the way of settling portions of Australia, because a people may for the most part be judged and their future determined by the fight they make with the unfriendly forces of nature. Now, in many districts, even in those close to settlement, years have been known to pass without their receiving anything in the true nature of rain, nothing almost to damp the ground beyond a passing thunderstorm. But no Australian, any more than any one of yourselves, can be satisfied with the settlement of a country which largely consists of a coronet of great cities round a deserted rather than a desert interior. Yet we are bold enough to think that the menace which keeps the population to the coast will, year by year, give way to an incredible extent before the ingenuity and resolution of the Australian settler. What rain falls will be husbanded, running streams will be fully laid under contribution, artesian reservoirs are being tapped, even the bare sheets of rock or expanses of galvanised iron are utilised. Where all these fail we have, even in one case, turned back the winter floods of a stream that would otherwise have been lost in the ocean, and conveyed them for hundreds of miles at a cost of millions to water the arid interior. In a word, year by year we are encroaching on this barren kernel of the continent.

Do not let me, however, again omit to state that we have besides this arid centre tens of millions of acres of land fertile, well watered, genial in climate, still waiting for the axe and the plough ; but speaking in general phrases in regard to the settlement question, our three great needs are to prepare the land for the settler, to place and start him on his holding, and most difficult of all, to hold him there, himself and his sons. For we have to contend with that fascination, so fatal to the farmers' boys and girls, of the crowded city with its keener mental exercises, its perennial amusements, its chances of escape for ever from the monotony of the farm and the village. This is a puzzle of puzzles, not for us only, but for all progressive nations. How it will be met among ourselves it is not easy to say. The solution must be left to the free play of those indefatigable forces which animate and direct Australian life, with its promise of a readjustment of faulty conditions, its endless remedies for weak points in the social structure.

It remains to say a few words on a question which probably is exciting more interest in the Mother Country than any other social or political topic concerned with Australia—the action and the prospects of the Labour party in the Commonwealth. As you know, we have our parties, mostly replicas of your own, but our Labour party differs from yours, in that it is not only possible for it to rise to the Government of the State, but this result has been actually achieved in more cases than one. No party has been subjected to sharper animadversion, has even been a greater source of alarm, among the home critics,—and perhaps not a few individuals have deserved it,—than the party led by one of the sanest and most judicious of our politicians, Mr. Watson.

Now, I hold no brief for the Labour party ; I do not belong to it. But calm consideration may go far to discount the fears evidently felt in so many quarters. It is easy to take too censorious a view of the party and its true aims. It is only recently that the Labour party has acquired a position approaching command in any State. But lately it has all but secured a majority in the Federal Senate, due, I venture to think, not to numbers in its favour, but to the perfection of its organisation. In my opinion, it has yet to win the approbation of the majority of Australians, and much may happen before that majority has been converted to the extreme programme of labour views promulgated by the Caucus. We of the Commonwealth are subject to no panic terrors as to the political labour man and his works. Let us admit he is a Socialist. We cannot well call him otherwise when a foremost plank on his platform is the nationalisation of the means of production, distribution and exchange. But in Australia we have looked the Socialistic movement too squarely in the face to fall into any premature terror as to what the results may be. It has to be remembered that more than one cause has specially influenced in this direction the political thought of the Australian elector. I mention two ; the soil has been in all ages the seat of the more stable forces of the community, it is the seed bed of Conservatism, but almost from the first days of the grant of popular Government, the lands of the Crown were placed at the untrammelled disposal of the democracy. It was made the people's land to be treated as their will desired. And there was a second cause, the one great capitalist of the country, certainly the only capitalist who would accept the vast but necessary risks of the future, was the Government. Hence the conceptions both of omnipotent public rights over the land, and of the duty of the Government to see

no needed public work was wanting, fell completely into line with the predilections of the Socialist. That Socialism would run strong in the Australian blood might be expected in a land of wide social experiments; the intelligent and ambitious workman of American aims at lifting himself above his fellows by his personal endeavours. He is an individualist. The Australian dreams of using the powers of Government on behalf of his class, or as he calls it, the people; he is a collectivist. On all sides, too, he sees nationalisation in full play, not merely as you have it here, such as posts and telegraphs and the common defence, but in regard to railways, harbours, drainage and water supply, roads and bridges, municipal amusement, parks and zoological gardens, charity, regulation of conditions of labour in all employments, mines and factories, by land and by water, and in a host of directions as multifarious as they are regardless of past conventions.

There is little reason to doubt the sincerity of the Labour party when they claim that the aim which underlies all their efforts is to increase the wages, shorten the hours, and generally improve the conditions of the worker, but it is contended that they seek to achieve all this at the expense of another man's purse. Now I am not going into these vexed matters, either to question them or to approve them. I wish to draw your attention to the simple fact that a platform with which after all we, the Commonwealth, are the most concerned, excites so very much less perturbation in Australia than we find displays itself at home. Now, why, in regard to the politics of the Labour party, do we view aspirations and events alike with a calmness approaching confidence, even assuming that they are mistaken in their programme? Well, in the first place we remember that those who are making these social experiments, as well as those who are watching them, are after all the brothers and sons of the men who have shown themselves among the most practical of mankind, men who, if they find they have made a mistake, have been seldom long in retracing it. The Labour politician is just as keenly anxious to make a success of his life as any of those can be who are most convinced of the evil that this party is working. The political genius of the race is not dead simply because it has been transplanted to alien skies, and breathes in other seasons. Further —and we need not speak of interference with immutable economic conditions, for time only will show what laws are inexorable, and what only temporary and provisional,—all Governments who hope to retain office in Australia must both conform to and satisfy the demands of Australia on four main points —population, revenue, employment, and co-operative union with the Empire. If a party fails in front of any of these goals, its fall may be delayed, it cannot ultimately be averted. The Labour party are, therefore, standing at the bar of the same tribunal as those who are opposed either to their aspirations or their methods, and if the practical men of the advanced party find their programme untenable, there can be few things more certain than that they will lead the way as a mere measure of self-defence in readjusting their blunders. Moreover, we have had experience of Labour Governments. In Western Australia one was in power for a year and another held his Majesty's commission in the Commonwealth for a shorter period. In regard to both cases, I believe most will agree with me the actual administration was little to be distinguished from that of the ministries which preceded and followed them in State and Commonwealth alike. Perhaps they are safer under the responsibilities of office than with the guerilla freedom they may otherwise enjoy. There is no doubt one quarrel which we are not likely to make up with the Labour party; that which concerns the work of the "machine", as it is called—that caucus forge from which comes the inflexible and relentless instruction which seeks to bind the labour men in invincible chains, is, in my judgment, more likely than not to make ultimately for the electoral and political undoing of the party. It is not a weapon which the free men of Australia of any class are likely to add permanently to their arsenal. Nor do I hesitate to say, after seeing it from inside and outside in operation for an entire year, that, in point of fact the caucus system, when applied to the work of administration, has hopelessly broken down. Meantime it is well to recollect their great organisation and the loyalty of its members have given the party an influence out of all proportion to its numbers; if the men and women of Australia truly object to the domination of labour, they have only to leave their offices and drawing-rooms for a few minutes, and come to the polls. It is time to close these remarks. Will you allow me, however, to leave you with an appeal? I entreat of you to believe that the men of the Commonwealth are fully conscious of the great trust held by them primarily for the good government and welfare of their

own people, but to be further employed in promoting the unity and strength of the Empire, and that that trust, as splendid as it is responsible, will, as I am convinced, never be betrayed. But we ask some confidence should be placed in us. One of the greatest of privileges has been allowed us, that of administering a continent, we understand well that that privilege is the mother of even greater obligations.

DISCUSSION.

The CHAIRMAN said that the real audience which he hoped the paper would reach, namely, that which was not familiar with Australian affairs, and which was not able to appreciate all the work which had been put into Dr. Hackett's valuable paper, was not present in the building, but, in addition to addressing the audience, lecturers at the Society of Arts had the opportunity of addressing those who were not present by means of the publication of the paper in the *Journal*, and it was to them that he hoped the message of the paper would be conveyed. The author's cheerful reference to the admirably low standard of the homicidal propensities of the Australian people, was in his (Mr. Deakin's) opinion due to the fact that they would not listen to statistics, but probably there were many present of a mathematical capacity who would be able to carry away the real lessons which underlay the appalling tables which Dr. Hackett had most legitimately presented. The people of this country did not realise in any respect the relatively remarkable prosperity which obtained throughout the whole of Australia, nor the enormous wealth of that country and its inestimable opportunities. They did not feel that the great figures which were occasionally placed before them were the achievements of a mere handful of people, having relation to the great extent of country which required to be occupied, and consequently the ungrateful task which the author had undertaken, of condensing into the form of unanswerable figures the demonstration of the truth of his own assertion, was, and would be, a valuable asset among the many valuable papers which the Society had published. He hoped the paper would be widely circulated and closely read; it would bear very severe criticism, for the author was a practised writer as well as speaker, and had weighed his words well; in fact, he had been almost too judicial in his attitude, in order that he might relieve himself from the charge that he had unduly favoured his own country. Without being one of the seniors of the Commonwealth, he (the Chairman) was old enough to remember that the whole period of their history had been one constant process of disillusion, and disillusion of the most happy character. When Australia was first settled in New South Wales, the great doubt expressed was whether the country would be able to feed its own few hundred people, but now that country could feed a great part of the Motherland and its own millions as well. The country between the mountains and the sea, which was at one time considered utterly hopeless, and was regarded as a Sahara, and into which when men visited it they took their lives in their hands, now bore millions of sheep, and returned to the people millions sterling a year for the wool from which they parted. At that time the enormous extent of Queensland was a hopeless no-man's waste, which in his recollection men feared to confront, and men who invested their money there were thought to be entering upon a hopeless undertaking. But to-day there was no part of the British Empire which had greater prospects of every kind than Queensland. The author in one part of his paper described the interior of the Commonwealth as a barren kernel. He admitted the kernel, but denied the barren. Subsequently, in a very happy phrase, Dr. Hackett described the whole of it not as a desert, but deserted. A place could not be deserted which had never been occupied, because the occupation of a few aboriginals did not deserve that name. The fact was that the country was not a desert in any portion of it that had yet been reached, and the conquest of the country was advancing with greater rapidity in every decade. What the author had said about the tens of millions of acres of well-watered, rich land, which might be cultivated by ordinary European methods, was perfectly true. The great disadvantage of Australia had been, not only in its remoteness from the Mother Country, but in the fact that every one of its appearances was a living and actual contradiction of the appearances of this country. The people of England looked with pride upon their green fields, and very beautiful they were; and the men and women who went to Australia from England looked with disdain upon the brown grass fields, until they found that that brown grass would turn off cattle and sheep as fat as English green fields would. It took a long while to wear the superstition out of a man of English experience. The Australian emigrants came from a country in which the danger to agriculturists was too much water, and went to a country where the problem was how to deal with the least possible quantity of water. Then with regard to the mineral resources of the country, some of the richest gold-bearing strata in the world, which was found in that country, looked to the eye as if they contained no more gold than a piece of wood, and everybody, except a mineralogist, would have walked over such ores all their lives without suspecting that there was a grain of gold in them. The consequence was that in Australia they had from the start to the finish to fight against the inherited superstitions attached to the Old Country, which their fathers had brought with them from over the seas; and it was not until such things were swept out of their minds, and the test of actual experience applied, that the riches of

the country had been really discovered. Even in the last ten years the cultivation of the country had been revolutionised. In Victoria and New South Wales, land which could have been bought ten years ago for £1, and even in the more settled places £3 and £4 an acre, had now risen to anything from £6 to £8 and £10 an acre and upwards. The introduction of superphosphates and new methods of cultivation had added millions of acres to the grain-bearing territory right within the well-settled districts. In the same way settlers were now pushing out, with the advent of better water supplies, into what used to be called the "Never Never Land;" and he was assured by the people who lived there that they saw their way to carrying on the poorest of the soils what they had not dared to venture to expect to get on the best of them. What Australians had to face in the way of drought losses were due chiefly to their own fault—to an over-stocking of the country which its circumstances did not justify. They risked enormous losses when they plunged in pastoral affairs for great profits. If the land was worked with fair numbers, it could be worked with very small losses and certain profits; and it was partly because of the gambling instinct and partly of the greedy instinct, that losses had to be recounted, when periods of drought came, on the part of men who had multiplied their stock, and who had minimised the proper provisions they ought to make for watering their stock. Australia was a great country; he believed in it from the bottom of his heart, because every experience in his long life justified his faith in it. If there was desert country in Australia they had yet to find it; and, by a curious dispensation of Providence, where stock would not grow the soil was full of gold and other metals. He had it on the authority of two of the highest experts in the treatment of minerals in the wide world who had recently visited Australia, that in that territory there were greater supplies of minerals in sight, untouched, than in any other country in the world. Australia was a gold-producing country, but it also produced every other metal that could be mentioned. In the north-west there were those rare metals which were now coming into such demand for improving the quality of steel in connection with the lining of guns, metals of extremely rare value, because they were particularly rare, but which were bound to become more and more in demand, not only in connection with preparations for war, but in the triumphs of peace in the preparation of high-class machinery. There were larger deposits of those rare metals in the great North-West than in any other place yet known in the world. So that where Australia did not produce sheep, cattle, wheat and wool, it produced minerals. It could produce ten times more than it had ever yet produced, and that within a reasonable time if the population was forthcoming, if they were only content to learn the lessons of their own country, as the Australian people were beginning to do, and trust that every part of it could be made productive. Dr. Hackett alluded to the fact that Mr. Price and himself had made an agreement which handed over the great Northern Territory from South Australia to the Commonwealth, and that it would be undertaken as a Federal Territory. That was a mere trifle. The handing over of 500,000 square miles of territory, a tract bigger than the German Empire, was a typical Australian transaction. That land would be disposed of in one transaction, if Parliament endorsed it; and if the Commonwealth obtained it, the first thing it would do would be to carry out a scheme, which had been prepared in rough outline, for putting 5,000 families, altogether about 25,000 people, on the rich lands of the North which were capable of producing anything. The greater part of that tract was a plateau, where there were cool nights, and where it was possible to grow the finest horses and cattle in the world. He had been introduced to a man nearly eighty years of age, a nephew of Richard Cobden, who had spent his life on the York Peninsula, yet in spite of his age, he was strong, stalwart, and of a ruddy complexion; nevertheless it was said that the climate there was such that a white man could not live in it. There was nothing that Australians would not believe about their country when it seemed to reflect on its possibilities. He thought one of the great truths which had been illustrated in the author's admirable paper was the splendid financial position of Australia at the present time. It was doing an export trade of 20 millions more in the present year than in the first year of the Federation, six years ago, and the States were doing a trade of 26 million pounds more between themselves now that the Commonwealth was one industrial whole; the two items together meaning an increase in the transactions of the Commonwealth of 50 million pounds a year. With that record, what more could be wished for? There was an opportunity in the country for population, and it must be remembered that the country might draw other populations than British. A condition, however, was made in regard to every emigration proposal that it must be submitted in this country first, and the emigrants from other parts of Europe were only asked for and sent when the old stock could not be obtained. Australia had a certain control over contract labour, but it had no control over any white people, and sought to exercise none, who chose to come to Australia; they welcomed them from wherever they came, gave them the full rights of citizenship, and made no attempt to exclude any who might not be British if they were of European blood and breeding; but they hoped never to see them settle in isolated communities, speaking any other tongue than English, or attempting any other form of organisation. Australia wanted people who would stand with them, and that was why they came to Great Britain first. They began in England because of the ties of blood, and returned to this country again because they wanted men and women who were already fully equipped, not only with their inherent endowments of character, but with the traditions, the

habits, and the practice of the race which they prized and cherished, and from which they would not willingly depart. That was why they always looked to Great Britain first and last to obtain all the adventurous members they could; and he hoped Dr. Hackett's paper would be, as it ought to be, one of the active agencies in attracting to the shores of Australia as many as possible of those who desired to leave the Old Country.

Mr. Deakin being obliged to leave for an important engagement in connection with the Colonial Conference, Sir WESTBY B. PERCEVAL, K.C.M.G. (Chairman of the Colonial Section) took the chair.

The Hon. W. M. HUGHES (late Minister for External Affairs) said that Dr. Hackett's papers, like the doctor himself, were so very pleasant that it made the task of following him rather difficult, just as an enemy who met one with a pleasant smile, a cordial handshake and his arms full of presents, made it extremely difficult to work oneself up to that state of enmity which was desirable under the circumstances. He, therefore, found himself very loath indeed to say one word against the paper, as the author had treated the Labour party, to which he (Mr. Hughes) had the honour to belong very well indeed. Dr. Hackett had said that the Labour party would be a very decent organisation if it were not for one or two things, one of which was its platform, and the other its practice. But that might be said of almost anybody. For instance, it might be said of a man that he would be a very good Christian if he did not drink and would only believe in the Bible. In the same way, it might be said of the Labour party that they were good citizens, only, of course, they did not believe in their platform and their practice; their caucus and their methods were abominable. Mr. Deakin was in the position that he believed in their platform, but abhorred their practice. He (Mr. Hughes) did not know that it was necessary to defend their platform, but, so far as he had noticed, Dr. Hackett did not seem to know what their platform was. That, however, was nothing new, because it was always those who knew least about the platform and opinions of the other fellow who were the most effective in denunciation. Each party had a very large share of the truth in them, and if one could only see both sides, and was not too blown out with self-conceit, very much was to be seen which could be admired in the other man and his party. The author had said that the Labour party were Socialists. Personally he had fought an election, appearing on various platforms on the average three times a night, and during the whole of that time he declined on behalf of his party to be bound by anything more than the platform upon which they stood, and that platform was not a Socialistic one. The Socialistic party of the State to which he belonged denounced him very heartily, upset him tooth and nail, and did all they were able (which was very little) to bring him and the party to which he was attached down. It was quite true that another party said they were Socialists, namely, the party to which the author of the paper belonged. Mr. Reid, the leader of a party in the Federal Parliament, said they were Socialists, but nevertheless Mr. Reid for very many years was content to hail him as his brother, speaking most kindly to him and of him, and always made exceptions, in his fiercest denunciation of the party of men of the names of Brown and Hughes. Times had changed, and politicians changed with them. He supposed that maxim was known in England; if it was not, the people of this country did not watch very closely what went on. Mr. Reid had been in various positions in his time, and had now taken up, as he always did, a final stand, which they expected him to keep for quite a while. The author had mentioned the Labour caucus and its influence. A caucus might want defining in Australia; it did not in England, where every party had a caucus, and where every party that was in power had a party which was notoriously governed by its caucus both inside and out. There was another party in the House of Commons, the Irish party, which had its caucus, and moved like a machine in a mysterious way, but very effectively, and all the more effectively for being mysterious and moving like a machine. Doubtless the Conservative party and the Labour party had their caucus, too. The Labour party of Australia had its caucus, and thought that it was ever so much better to speak with one tongue than with many. That was discovered long before the present time. The people at the Tower of Babel spoke with many tongues, and the result, therefore, was not effective. As for the good the Labour party had done, and the evil that would live after them, there was no necessity for him to prove that the caucus rule, whether it be good or bad in principle, had been bad in result, because the author most effectually dispelled any idea in that direction. For the last fifteen years the Labour party had been a power, and for the great portion of that time it had passed really effective legislation. It had been said that the country was going to the dogs; but soon after Adam's time people arose and said that, and, when all the people who were at present living were dead and gone, some other equally foolish persons would arise and say exactly the same thing. The country had been going to the dogs to his knowledge since he was born, and it would go to the dogs in an equally satisfactory way, he presumed, long after he was dead. The result of the fifteen years of Labour domination in Australia was seen in the figures given by the author in regard to the advance in shipping, the general trade of the country, and the amount of money in the banks per head of the population. The figures showed conclusively that, whatever the Labour party had done, it had not been able to prevent Australia going ahead in such a way that no other country in the whole of the civilised world had been able to do.

The Labour party was accused of being a Socialistic party, and no doubt it was Socialistic if to be Socialistic was to try and lift up the people to enjoy a decent and respectable state of existence. If to put into cultivation five million acres in the last ten years was Socialistic, they had been Socialistic; if to tax unearned increment on land, on which certain individuals had done none of the sowing and did not deserve the reaping was Socialistic, they were in favour of it, and he understood that so respectable a man as Sir Henry Campbell-Bannerman shared the same opinion. It was said that all people were Socialists now, and to an extent they were. A number of the Australian Labour party might say wild and extraordinary things, but there were wild people in every party who said extraordinary things. The Labour party of Australia was not to be condemned for the sayings of one or two of its members, any more than any party was. The Australian Labour Party's ideal was to enable every man to get a fair opportunity of earning a living, and, thanks to that party, people could, in Australia, get in very many cases a better chance of doing so than in any other country in the world, and he ventured to say that the condition of the people was, all things considered, fit to be compared with the condition of the people anywhere else. Property was perfectly safe, interest was reasonably high, profits were good, and trade was very fair. According to the author they had had three good seasons, and he believed Providence was going to be kind enough to give them another. There was in New South Wales sufficient good land to keep fifty millions of people; it had a greater rain-fall than England, and in fifteen years out of sixteen was not visited by drought. Dairying, agriculture, and fruit culture could, and ultimately would, be carried out. But Australian people had to work. Neither his party nor any other party had a solution for the man who would not work. A loafer, whether he be a rich loafer or a poor loafer, was not wanted in Australia, but men who would work hard would get a good living. If people nowadays did not work hard and keep their eyes open they would be a failure in Australia, as they would be anywhere else. The figures given by the author spoke for themselves, and the fact that the party to which he (Mr. Hughes) belonged, had steadily increased in numbers, year by year, showed that it was not inimical to the interests of the country, and that on the whole, it was the party best worth trusting in the Commonwealth.

Lord BRASSEY, G.C.B., said that all present had listened to the paper with feelings of admiration for the marvellous wealth and prosperity of Australia. But there was something more than that to be admired, namely, the splendid qualities of the people by whom those resources had been developed. Mr. Deakin had described the appearance of the country, and those who had seen and travelled through it, knew very well that Australia would never have yielded her fruits to idle hands. There had been, and still were, many difficulties in the development of the country, but many of them had been overcome by the fortitude, energy and enterprise of those who went forth from the old land, and by a spirit which never surrendered to temporary failure or disaster, and which finally triumphed over all obstacles. They admired not only the result that had been achieved, but the qualities of the men to whom those results were due. Australia had been remarkable not only for the success which had attended its enterprise, but the country and its Government offered this country very useful object-lessons in many matters which deeply concerned the people, to which public attention was very properly being directed at the present time. Wages boards, old-age pensions, arbitration between employer and employed, were some of the things which were now occupying attention, and useful lessons might be learned from Australasian experiences. He was glad to know that it had been resolved to make inquiries on the spot, and to profit by the lessons which Australia had to give to the old country in these important particulars.

The Hon. Sir JOHN A. COCKBURN, K.C.M.G., thought it was impossible to say anything on the subject after a scholar like the author, a silver-tongued statesman like Mr. Deakin (one of the most sincere and earnest-minded statesmen he had met in his life), a protagonist like Mr. Hughes, and a nobleman like Lord Brassey had spoken, except that they all rejoiced as Australians that Australia had been put before the audience that afternoon in its clear and true light. When that was done, all the blue spectacles in the world would not suffice to dissipate the *couleur de rose* with which everything Australian was naturally permeated, because it was the land of prosperity and hope, in which the British race flourished better than it did in any other part of the world. That was the greatest possible tribute to the British race. If a tree were taken out of a nursery, where it had not room to develop, and planted in the open, very soon the full symmetrical development of its foliage would be seen; and when a Britisher was given a chance the analogy held good. In the people of Australia they saw as in a larger mirror the reflection of the features of the people of the Mother Country. With regard to the question of population, Mr. Deakin had referred to an arrangement arrived at with the Hon. Thomas Price, the Premier of South Australia, who was one of the Labour party, and who had done more statesmanlike things for South Australia than anyone who had held the reins of government there. The arrangement included the building of a railway across the continent, and it would not be long before another railway would be constructed connecting the Eastern States with Western Australia. Those two lines were absolutely indispensable to the development of the vast continent, and he thought there was no doubt whatever that, in their construction, sources of

wealth would be opened up which would remove once and for all the only reproach which could be brought against Australia—its deficiency in population. He believed that those two great works would attract population; and although every means had to be used to populate Australia with white people, it was a great deal better to draw them in than push them in. That was the true explanation of Dr. Hackett's statement, that in all cycles of prosperity there was an increase of population in Australia. With regard to the question of the legislation of Australia, it was both Socialistic and Individualistic. He gathered that the aim of Individualism was to secure to every man the fruits of the labour of his own hands; and he thought there was not a measure that had ever been placed on the Australian Statute-book that had not that aim and operation. One might call it what they liked, but he maintained it was individualism in the truest sense when the resources of the State afforded every man an opportunity of earning a living and enjoying the fruits of his labour; and that was the characteristic of Australian legislation.

Dr. HACKETT, in reply, said it would take a whole evening to deal with the points that his friend, Mr. Hughes, one of the fairest and most capable of the members of the Labour party, had made. He did not desire to say anything, except to thank the audience for the very kind hearing he had been given.

Sir WESTBY B. PERCEVAL, in proposing a hearty vote of thanks to Dr. Hackett, said all present would agree that they were much indebted to the author for his interesting and instructive paper, while a larger audience outside, who would subsequently read the proceedings, were equally indebted to him. He took the opportunity, as Chairman of the Colonial Section of the Society, of tendering its thanks first of all to Mr. Deakin for gracing the proceedings with his presence, and, secondly, to Dr. Hackett for his valuable paper The paper was, in his opinion, a remarkable testimony to what might be called the resurrection of Australia. Those who had been associated with Australia, and see the Australia of to-day and compare it with the Australia of seven years ago, if they had not known something of the recuperative powers of the country, would not believe that they were one and the same. The enormous strides which had been made in production and in wealth were astounding, and one of the great needs of the present day was a proper appreciation of the enormous growth which Australia had made in recent years. Growth was not confined merely to Australia, and very much the same condition of things was seen in Canada, and he hoped before very long, would be found in South Africa. He very much feared the people in this country did not understand the rapid development of the young nations, and the possibilities which were in the hands of the Empire in combining its resources.

The vote of thanks having been unanimously adopted, the meeting terminated.

Sir CHARLES MALCOLM KENNEDY, K.C.M.G., C.B., writes:—

The proceedings at the meeting of the Colonial Section on the 23rd April form valuable contributions to the records of the Society of Arts. Dr. Hackett's paper is an up-to-date statement relative to the social and economic condition of Australia, while the speeches of Mr. Deakin and Mr. Hughes afford clear and authoritative summaries of the views of Australian statesmen. The paper and speeches open out certain points which deserve further consideration. The position of Australia in connection with divergent international aims and policy in the southern seas is a matter of very real importance. The results of changes now going on in these regions will, in their final settlement, depend upon action taken in the island continent itself. Hence the policy of the several States, and of the Commonwealth, in matters affecting the position of Australia will have far-reaching consequences. The two main factors which must determine its position in relation to rival influences are money and men. Events may easily occur in which Australia may be dependent, for a time, on its own resources. Its population and available capital are disproportionate to the strength of States which may come into conflict with Australia; and for a time this disproportion may bear untoward consequences. Newspaper reports of local opinion and legislation render it doubtful whether the vital importance of encouraging immigration, and outside enterprise and capital is sufficiently appreciated. Present Australian ideals may confer comfort and enjoyment. But there is reason to fear, in the interest of Australia, lest conditions of temporary ease should in a period of conflict and stress place the country at a disadvantage. Then as regards the development of Australia, the caution of the late Sir Daniel Cooper, a member of the Colonial Section of this Society, should be borne in mind. The reports of experts and promotors may be correct within their literal wording. Yet there may be other facts which render them nugatory. "Good things" are usually taken up on the spot. Careful investigation is needed in regard to schemes laid before the investing public in this country. The action of Government in Australia is also uncertain. To cite an instance with which I am personally acquainted. Ten years ago steps were formally sanctioned by the Government of Queensland, and approved by the Colonial Office, to develop British New Guinea: if they had been duly carried out, much progress would have now been effected. Adverse feeling was aroused in Queensland, New South Wales and Victoria, and the sanction given to the scheme was withdrawn. I fully admit the right of an Administration to adopt an altered policy of this nature, if they are satisfied that the public interests intrusted to them require

this change of policy. But in this contingency, public faith and policy suggest equitable consideration towards the contributories to an undertaking which is at first sanctioned, and ultimately cancelled. The three Colonial Governments concerned, referred the matter to their Agents-General in London, who, if I am not misinformed, recommended a payment of £4,000 in settlement. The Governments, however, adopted the unusual course of declining to adopt the recommendations of their own Agents. And lately the Commonwealth Government, which seems to have taken over British New Guinea affairs, offered a new arrangement, which does not meet the case, and which is not acceptable on the money market. It would certainly seem the better course to accept, in principle at least, claims recognised as valid by the Agents-General, and to settle them without delay. To ignore a claim of this nature will imperil the credit of the Commonwealth. We may sympathise with, and admit the policy of a "white Australia." At the same time it is well to state, and to give attention to, various questions of policy and fact affecting the economic conditions and welfare of Australia. The true and permanent interests of the several States, and of the Commonwealth, will be served by careful consideration of all such questions. We must trust that the people will examine dispassionately their external and home affairs, and that their good sense will lead them to establish the bases necessary for the maintenance and the progress of their national existence.

TWENTIETH ORDINARY MEETING.

Wednesday, May 8, 1907; SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council, in the chair.

The following candidate was proposed for election as members of the Society:—

Smith, J. Landretto, Glenfield, St. George's, Grenada, British West Indies.

The following candidates were balloted for and duly elected members of the Society:—

Evans, J. W., Cobalt, Ontario, Canada.

Lee, William Harold, Sudan Railways, Shendi, Egypt.

Madunji, Pandoorung, 925, Bhandarwada-road, Dadur, Bombay, India.

Muntri, Narayen Govindjee, 192, Worlee-road, Bombay, India.

Rule, Thomas, Oceana Consolidated Co., Ltd., Kaombi, Chiromo, British Central Africa.

St. Quentin, F. G. de, British Consulate, Prague, Bohemia.

The paper read was—

THE PRODUCTION OF COKE AND ITS APPLICATION IN DOMESTIC FIRES.

By Paul Schlicht.

The honour you do me by your presence to-night impels me to ask your kind indulgence if it appear to you that I do not bring to my subject a knowlege co-extensive with its importance. I bring, however, the devotion of a close student of coal and its uses, the experience of a more than ordinarily zealous and industrious experimentalist, and the consciousness of having achieved a certain measure of success in devising simple methods of improving combustion that are daily contributing to the comfort of thousands, and to the economic use of fuel, in and about the city of New York. My recent activities that have had to do with the production of by-product coke for metallurgical purposes and the advocacy of the production of improved coke by gas companies, have led me to investigate the different methods of coke and gas production in the United States, England, Germany, Austria, and Belgium, with a view to finding the best and simplest methods.

Although I may seem to exceed the limits of my subject, I have touched upon other matters only because they seem to me to have direct bearing thereon.

I accordingly divide my paper into the following parts:—

1. The Use of Bituminous Coal.
2. The Production of Coke.
3. Kinds of Coke.
4. Application of Coke in Domestic Fires.
5. New Method of Combustion.

The Use of Bituminous Coal.

The impression vaguely prevails that the *per capita* consumption of coal is a fair criterion of a nation's rank in the world's civilisation. The truth of this statement, however, depends upon whether the use approaches the highest economic standards of the day, or, if not, whether the abundance of a country's coal resources excuses misuse and waste.

Applying these preliminary remarks to England, it does not seem to me, from the report of the last Royal Commission on the Coal Supply, that the validity of the contention of the late Professor Jevons, supplemented by the later more carefully statistical calculations of Mr. Price Williams, as to the early exhaustion of the coal fields of England, is materially affected. Yet raw coal continues to be "destructively" distilled, and, what is worse, the

lungs of the public continue to be impregnated with carbonaceous matter and sulphuric acid, attenuated, it is true, by the immense quantities of water, in the form of steam, that each little chimney-pot throws out. Why is it that only the wholesale industrial atmosphere-polluters are prosecuted and the equally guilty house-dwellers continue their more insidious, if homeopathic, air-poisoning unmolested? Let us look across the Atlantic. It can be truly said at least of the eastern portion of the United States, that the atmosphere is not blackened by domestic fires. Anthracite is the popular fuel, but latterly by-product coke has come into vogue in the communities where it is being produced.

Shortly after the adoption of bituminous coal as a fuel in England, a Royal Proclamation was issued forbidding its use, and authorising the destruction of the furnaces of the users, who were characterised as evil-doers. Scarcity of fuel it seems shortly compelled the resumption of its use. In the reign of Elizabeth, bituminous coal was again prohibited during sessions of Parliament, lest the health of the members should suffer thereby.

Hygienic objections to bituminous coal must have been gradually overcome in London, or the inhabitants must have grown more indifferent than in a simpler age, for deaths by the hundreds of thousands are traceable to the poisonous and fog-contributing exhalations its improper use gives rise to according to reliable chroniclers.

It must be said, however, that in recent years, thanks to the admirable and disinterested efforts of the Coal Smoke Abatement Society, and the exploitation of gas as a substitute for coal by the gas companies, the atmosphere of London is much less offensive than it was twenty-five or thirty years ago.

With your kind permission, I will introduce on the screen two photographs loaned me by the Gas Light and Coke Co., of London, showing the effect of chimney smoke on the atmosphere, the one taken before the lighting of fires in the early morning, the other some three or four hours afterwards. These photographs were taken from the roof of Cannon-street Station, and tell their own story.

For many years the smoke nuisance of London has really been indefensible. In Washington, the capital of the United States, there is no smoke nuisance. The owner of a furnace as well as the stoker are both liable to fine and imprisonment. This is full of suggestiveness for London. In New York until recently, practically a smokeless city, it is true that certain large fuel-users, feeling obliged to work their boilers to the bursting point, use bituminous coal on dark nights, and thus evade the lynx-eyed smoke ispector. The condition of the atmosphere the next morning, however, is tell-tale.

FIG. 1.

When one looks at a bright cheerful open fire, radiating its genial warmth, even though only a little way, into the room, one rarely stops to think what it is that is actually taking place.

The process we witness is aptly called "destructive." Yes, this coal, so laboriously extracted from the bowels of the earth, that men daily risk their lives to secure, that is

FIG. 2.

screened and picked and loaded in cars and vessels, unloaded by hand or ingenious mechanism, stored by the coal merchant, and made the subject of trusts and syndicates, how much of it in this wanton work of distillation is actually made to serve a useful purpose, and how much is destroyed or passes off as a polluting or fog-promoting emanation?

In addition to wastefully heating about fourteen times the air necessary to burn the coal and generously sending it out of the chimney into the open, together with enough water in the form of steam, impregnated with sulphuric acid, to produce a miniature fog, we destroy per ton of coal burned, as high as one hundred pounds of coal tar, countless constituents valuable in the arts and medicine, oils that give promise of success as the basis of illuminants and heating agents, and that are already being used for motor purposes as substitutes for petrol, as well as heavier oils, together with solids that can be employed advantageously in road-making and road improvements, in addition to their regular commercial uses; considerable quantities of ammonia, useful in the arts and invaluable in the form of sulphate of ammonia for agricultural and other purposes; cyanogen, in not inconsiderable quantities, either in the rough as prussiate of soda, or that may be converted into the various cyanogen products of commerce.

If this same ton of coal were used in the modern by-product oven there would be in addition to the products named, 14 cwt. of coke suitable for domestic and metallurgical purposes which improved coke can be made to serve a much more useful purpose than the raw coal giving in addition thereto at least 5,000 cubic feet of gas suitable for illumination, heating, and power purposes.

The poverty and inadequacy of these utterances respecting a popular use of bituminous coal, I fully realise when I consider the beautiful distillates that discovery and invention have enabled us to recover from this misused product of the sun's rays in the form of solids —crystalline and pulverulent of all the beautiful colours of the rainbow—liquids of varying specific gravities and boiling-points, gaseous constituents capable of many combinations. I leave this task to those more learned than I. The name of a great Englishman, Perkin, springs to the lips when this subject is adverted to. What a service he has rendered mankind! Small wonder then that the late Sir William Siemens (then Mr. C. William Siemens) in 1881 in an address before the Glasgow Science Lecture Association, declared:—"I am bold enough to go so far as to say that raw coal should not be used as fuel for any purpose." And this was before the advent of the modern by-product oven and its successful use in the manufacture of illuminating-gas and a high-grade coke!

I cannot conclude my remarks on the use of bituminous coal without quoting from the report of an address delivered at the recent annual meeting of the Coal Smoke Abatement Society at which the King's surgeon, Sir Frederick Treves, stated that he could personally say from what he had seen of the lungs of dead persons in London that they were absolutely black on the surface and down to their very depths; that the trouble caused by impure air was the starting point of serious diseases, and appalling misery that words could not portray. He added that the sooty substance blocked the lymphatic vessels and also the bronchial glands and lessened their power to resist disease, that the lung of the smoke-breather was already compromised, and that this appalling combination of soot and sulphuric acid was a great irritant to it; that all kinds of catarrh and bronchitis were produced by this matter, and catarrh was the starting point for more serious trouble in the chest. That fog would exaggerate to an intense degree all forms of lung trouble and killed Londoners not only by hundreds but by thousands. I was not present at this meeting and, therefore, quote from the newspaper reports this portentous warning.

Reverting again to the genial open-fire the passion for which would seem to warrant the designation of fire-worshippers to the Anglo-Saxon race. Are there not improvements at hand for using this raw bituminous coal, now so wastefully burned, that pollutes the air, contributes to fogs, poisons the blood, hastens death, and requires the dwellers of cities to make periodic pilgrimages to regions of purer air? Yes, or fuel that does not smoke, that will burn brightly, radiate more heat, last longer, can as I have before stated, be produced from this very coal if the gas companies in London and elsewhere in England can be shown the economic advantage to be secured by adopting the modern by-product oven so successfully employed in the United States. A high grade of coke of different kinds can be economically produced in such ovens, of varying degrees of density, porosity, and clean volatile matter, by merely varying the coking periods. Flaming coke for instance can be made in from four to five hours less time than the low volatile coke required for metallurgical purposes, a certain percentage of hydrogen and hydro-carbons that during the latter part of the coking period require much heat to expel, being allowed to remain in the coke. Coke for metallurgical purposes which should

have less than one per cent. of volatile matter can be made in the same ovens, thus supplying fuel for domestic, metallurgical, and other industrial needs.

THE PRODUCTION OF COKE.

Coke may be described as the carbonaceous residual of bituminous coals remaining after the expulsion, by heat, of the larger part of their volatile constituents. While its production between 1612 and 1621 seems certain, there is little reliable information as to who is really responsible therefor. Professor Jevons, relying on a work called "Metallum Martis," by Dud Dudley, natural son of Lord Dudley, containing accounts of the anthor's invention of the use of pit-coal for melting iron about 1620, and, later, of making coke from the small coals left in the pit, awards to Dudley the honour of having by this simple economic expedient laid the foundation of the iron industry of to-day. Records in His Majesty's Patent Office, however, cast doubt on these statements. In Patent No. 15 granted by King James in 1620 to Sir William St. John, Sir Giles Mompesson, Sir George Ayloff, Lewis Powell, Walter Vaughan, John Prothero, Henry Vaughan, Henry Stubbes, and Hugh Grundy, these patentees agree for themselves and their executors to pay for the privilege "the sum of five shillings for every ton of iron steel, brass, lead, copper, &c.," they may "make, fine, produce, or work by or with such charred fuels." The patent contains the following recital: "Whereas as heretofore upon the severall information first of one Simon Sturtevant and afterwarde of John Robinson made unto us, that they had found a way to "Melte produce, and make iron and divers other metalls and materialls with sea-coale, earth-coale, pit-coale, peat, turf, and brush, and such other like fuelle," a patent was granted them. The recital further states that this grant is cancelled, first, because the parties did nothing, and, second, because the method would be valueless "unless the coal be by some means corrected and purged from the sulphur or other contagious mixtures they contain;" but being informed by Sir John and others that "they have found ways and means to charke the several fuels of sea-coale whereby the same may be fit and serviceable as well for the uses aforesaid as well as other uses," they are granted the monopoly "to charke coal." Attached to the copy of these Letters Patent in the Patent Office Library, done into modern English, I find a paper that contains evidence that this early syndicate did not turn out as well as King James or the syndicate expected, for Sir Giles Mompesson, one of the syndicate that had agreed to pay into the Royal coffers five shillings royalty per ton of iron made, was, on the 26th March, 1621, degraded from the order of knighthood, the degradation "to occur whenever he shall be taken," his lands were declared forfeited, a fine of £10,000 imposed, "and lastly, he shall be for ever held as an infamous person."

The next patent has to do with coal products in which coke appears to be referred to as "cinders." I quote from it to show the then state of the coal products art. In 1781 there was granted to Archibald, Earl of Dundonald, a patent, for "A Method of Extracting or making Tar, Pitch, Essential Oils, Volatile Alkalies, Mineral Acids, Salts, and *Cinders*." (Italics mine.)

I summarise a portion of the patent. The coals, after being kindled, are enabled by their own heat and without the assistance of any other fire to throw off, in a distillation or vapour, the oils they contain. Persons doing this will be deemed to encroach this patent, because, as he avers the only means known until his new discovery was "a distillation of coal in closed vessels where the admission of external air was prevented and where other fuel and coal were required besides the coals contained in the closed vessel to produce the heat necessary to pervade the same." This patent was extended as the Earl had used up all his resources in attempting to put the invention into practical use.

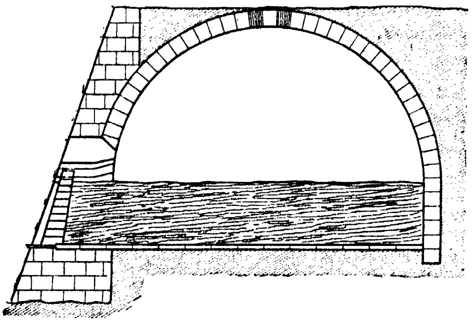
In 1783 Jean de Cannolle, described as "late of Paris but now of Piccadilly, London, Mineralist," obtained a patent for "a factitious coal to supply the use of charcoal more efficient in its qualities and perfectly innocent in its effects." His claim is, "The making, fabricating, or manufacturing of a factitious fuel by charring."

The production of coke in early times was doubtless due to the recognition of the advantage, as a concentrated heat producer, of a dense, hard, homogenous substitute for charcoal and pit-coal for the melting of iron. The process was called charking or coking, and was carried on in a manner analogous to that employed in the production of wood charcoal. The process passed through successive evolutions.

Whether coke be made in the primitive mounds, in ovens, heated wholly or in part by the gases evolved from the coal within the oven, or

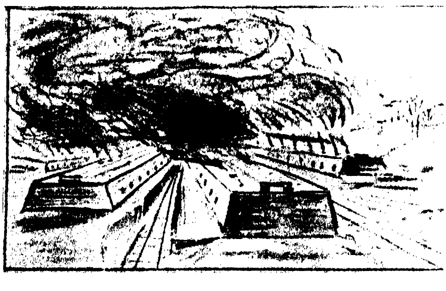
heated externally, the process as has already been stated consists, essentially, of the expulsion, to a greater or less extent, of the volatile constituents of the coal. The longer the coking period, heats being equal, the harder the coke and the freer it is from volatile matter. The latter portion of the coking period requires the expenditure of the greatest amount of heat. It required five to eight days to coke in mounds, it requires forty-eight and seventy-two hours respectively in Bee-hive Ovens, and the coking period in the modern regenerative oven has been reduced to twenty-four hours for metallurgical coke, and eighteen hours for domestic and industrial cokes which do not require the

Fig. 3.



Bee-hive Oven.

Fig. 4.



Bee-hive Oven Wastes.

complete expulsion of the gaseous portions of the coal, but are, in fact, preferable therewith on account of their flame-producing properties, greater porosity, and ease of ignition.

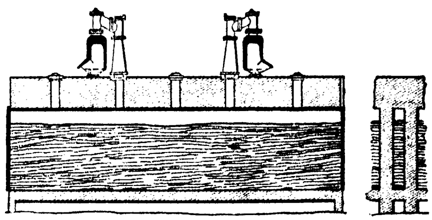
The art of making coke as practised to-day, consists, generally speaking, in the expulsion by the heat furnished in the burning of all, or a portion of the gaseous constituents of the coal, (1) within a coking chamber into which restricted quantities of air are admitted; or (2) heated externally thereby in a chamber from which air is excluded. The means for carrying out this art consists of ovens of fireproof material.

Ovens are roughly divisible into Bee-hive Ovens and Retort Ovens.

The Bee-hive Oven may be divided into (*a*) ordinary ovens in which all products except the coke are wasted, and (*b*) waste heat ovens in which the products are carried away by means of flues that their heat may be made to serve a useful purpose.

The Retort Oven may be divided into horizontal and vertical. The horizontal ovens may be divided into (*a*) non-by-product ovens, and (*b*) by-product ovens with horizontal or vertical heating flues. These may be further divided into non-recuperative and recuperative, and non-regenerative and regenerative. The vertical oven is a by-product oven, and

Fig. 5.



Retort Oven.

usually non-regenerative. The coal is fed into the top of the oven, and the coke discharged by gravity from the bottom of the oven. The charge is usually about two tons; the coking period with certain coals in as short a period as six hours.

The bee-hive oven is generally round, its diameter 12 to 15 feet, and its height 8 to 10 feet. The horizontal retort oven, which is the type of the modern by-product oven, has a long narrow arched coking chamber, with doors at each end, and may be from 30 to 40 feet in length, 18 to 22 inches in width, and 5 to 8 feet in height. In the bee-hive oven the coal is coked in a heap. Heat reflected from the dome ignites the coal. Coking proceeds from the top downward. The coke is quenched within the oven, and is withdrawn by manual labour. In the retort oven a long narrow high body is acted upon through the heating flues of the side walls. This narrow body is more quickly and effectively acted on than the large heap of coal in the bee-hive oven. Moreover, the charging and discharging of the coal can be done by machinery, and the coke quenched in the open. The coking period with the retort oven is shorter, especially where there are regenerators and coals that do not

readily lend themselves to the coking process, can, in the retort system, be compressed, moistened, and charged into the coking chamber in one long narrow cake, and produce coke of a quality impossible of production in the bee-hive oven.

The well-known retort ovens may be divided into those with horizontal and those with vertical flues. The type of horizontal-flued oven is represented by the Semet-Solvay, the Huessener, the Simon-Carvés and the Rothberg. The vertical-flued oven by the Coppée, Otto-Hoffmann, Otto-Hilgenstock, Collin, Koppers, and Von Bauer.

The vertical retort oven that deserves mention is the Appolt, first built about 1856, but generally superseded by the larger horizontal retort oven. Other vertical ovens are mere modifications of the Appolt.

The modern by-product oven seems to be the lineal descendent of the long narrow horizontal retort oven of which the Smet stands out prominently as a type. The Smet ovens were probably first built in 1848 and 1850.

Coppée in a large way, was practically the pioneer in the exploitation of the retort oven, by means of which coals that could not be coked in bee-hive ovens were made available for metallurgical purposes.

The father of Collin, inventor and constructor of the Collin oven, built Smet ovens in Germany as early as 1848.

Knab and Carvés used the Smet system in their by-product ovens, but the gas was insufficient for heating the ovens and coal or coke had to be used as an auxiliary heating agent. This gives some idea of the increased efficiency of the modern by-product oven and of the comparative efficiency of the by-product oven even as late as 1881, when Albert Huessener built his plant at Gelsenkirchen. The Carvés oven originated with Knab. Simon improved this oven and called it the Simon-Carvés.

In 1881, Dr. C. Otto experimented with Coppée ovens at Wattenscheid, Germany, "the heat being supplied entirely by cleaned gas, burning in flues surrounding the coking chamber." As a result, the firm of Dr. C. Otto and Company in 1881 constructed and exploited a form of oven in which the Siemens' Regenerator was employed to recover heat from the waste gases, and to supply heated air combustion, the oven construction being of the Otto-Coppée type, and generally known as Otto-Hoffmann oven.

There are differences of opinion as to the relative merits of the horizontal and vertical-flued oven that are due mainly to the question of the uniform-heating of the sides of the oven. The balance of opinion is in favour of the vertical it would appear.

My observation of the Huessener both at Gelsenkirchen and Middlesbrough satisfy me that for colliery and blast furnace use where surplus-gas is not important, it is an oven very well adapted to these uses.

Among vertical-flued ovens this may also be said of the Coppée and Otto-Hilgenstock, although Coppée, I understand, has under construction a regenerative oven intended to yield a large gas surplus.

The Otto-Hoffmann, the Koppers, and the Collin are the ovens which make substantial claims to producing largest yields of surplus gas and accordingly merit consideration in connection with gas production.

The adherents of Collin and Koppers claim much for their ovens, but the claim made for the new Collin oven is that it will give 10 to 15 per cent. more gas and materially shorten the coking period.

Otto-Hoffmann and Collin ovens have regenerators common to all the ovens. Koppers has separate regenerators for each oven.

In the Otto-Hoffmann and Koppers ovens one-half of the oven is heated directly, the other half indirectly. In the directly heated half of the oven the gas is burned at different points along the bottom of the vertical flues, the products of combustion rising in the one half descending in the other half of the oven, but heating that to only a moderate degree.

Alternate heating causes different differences of temperature; Collin proves that one half of such ovens to be always cooler than the other. In his latest oven which may be built higher than ordinary ovens he has methods for directly heating by contiguous vertical flues continuously from the bottom upward and from the top downward.

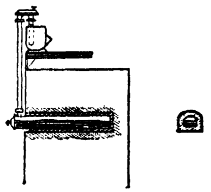
I must not forego proper mention of an interesting by-product plant I visited in Bohemia, at Wesseln, near Jeplitz, controlled by Imperial Justizrath, Dr. Aufspitzer, whose son-in-law, Herr Weiss, is the managing director. From the brown coal of that region, a very profitable industry is carried on in the making of coke for domestic purposes—coke of a high grade. The coal has about 35 per cent. of water. All the tar distillates are produced besides aqua ammonia, benzol, and gas for power purposes. The domestic coke finds a ready market, at a good price, in the large

cities. It is daily shipped. The oven is the improved Appolt; at this plant, the quenching is done without water. Another Appolt plant, for the same company, is being erected near by.

It will be seen that the coke-makers copied from the gas-makers. But the gas-makers have been thinking The recognition has tardily come that the larger units of the by-product oven, its greater life, the superior yield and quality of its products, especially its superior and varied cokes—domestic, locomotive, general steam-raising, and metallurgical—should long ago have impressed European gas-managers, especially after the excellent paper of Mr. Charles Hunt, now President of the Institution of Gas Engineers, read some twelve years ago before that Institution and the elaborate paper of Dr. F. Schniewind, read before the International Engineering Congress, 1901, so rich in reliable data, diagrams, and tables.

Coking is a carbonising process—so is gas-making. The processes in the gas industry of to-day are not as efficient carbonising agents as those employed in the modern coke industry, and generally speaking, the results per ton of coal carbonised in the by-product oven, of even low gas production, shows a more profitable carbonising system than does the older diminutive gas-retort system.

FIG. 6.



THE DIMINUTIVE GAS-RETORT.

Some of the foremost gas engineers and financiers of America are interested in gas-plants that owe their prosperous condition to the modern by-product oven. It is only fair to meet the objections that have been made by equally reliable authorities in England. They say they want gas—all of the gas. They want to have as little to do with coke as they can help. They may want all the gas, but do not get it. In a recent test made for me in America, it was shown that 25 per cent. less gas than was produced from an exceptionally good gas coal in the by-product ovens was produced in the modern gas retort. The average candle-power was also less, and the coke very porous.

A careful calculation shows that if all the gas for heating the ovens were added to the surplus gas, and the ovens were heated with coke or water-gas, or by-product producer-gas, the result would not be as favourable as if self-generated and automatically fed oven-gas were used for heating, provided always that a market could be made for the improved coke.

The economic advantages of the modern by-product oven were so well recognised years ago, as I have already stated, in America, that ovens were built near Boston in which coke is made, and all the gas to illuminate Boston and surrounding towns is manufactured. At Camden, New Jersey, some twenty towns are supplied with gas by the Camden Coke Company, controlled by the Public Service Corporation of New Jersey, gas being piped as far as Trenton, a distance of some forty miles. The gas for the city of Baltimore is made almost entirely in by-product ovens, and piped from the Coke Works at Sparrows Point. Both in Boston and Camden the exploitation of by-product coke has been very successful for domestic, steam raising, and metallurgical purposes. It has displaced anthracite coal to a considerable extent in many places, and is used successfully on locomotives and as a competitor of bee-hive oven coke.

KINDS OF COKE.

To the layman the word coke is a name applied to a product of the gas-works generally that has never been held in high esteem by those who use it, those who make it, or those who have heard of it; but this has been due in part to the ignorance of the best method of using it. Its porosity makes it bulk for bulk inferior in calorific value to the coal from which it is made, but of greater radiating power if properly used.

As has been seen, the bee-hive coke is very wastefully made, to the discredit of two such great industrial nations as England and the United States, 90 per cent. of the metallurgical coke being still produced in bee-hive ovens. The by-product oven is coming into favour with the progressive iron-masters of England, Bell Bros. Ltd., for instance, having done much to popularise by-product coke. In the late C. Lowthian Bell's paper read a short time ago before the Iron and Steel Institute of Great Britain, his favourable conclusions are given. I am greatly indebted to Sir Hugh Bell, the present head of the company, Greville Jones, works manager, and Dr. J. A. Roelofsen, manager

of the by-product plant, for valuable assistance in making tests with American coals.

If comparisons are carefully instituted between bee-hive oven and by-product cokes, it will be found that chemically the constituents are practically identical. Considered physically, the hardness and effective porosity of the latter makes it certainly equal, if not superior, to the former. The silvery colour of the bee-hive coke, due to a graphitic coating believed to protect the coke from dissolution by the hot gases of the blast furnace, is made up for by greater hardness and a more uniform porosity in the by-product coke. So great, however, is prejudice, even at this late day, and in the light of what is being done by the foremost ironmasters, that important industrial centres in England are still prejudiced against the use of by-product coke. In both cases the volatile constituents of the coal are either driven off or a portion thereof deposited to add to the bulk of the coke; in the one case, however, these gases are generally driven off into the open air and wasted, in the other they are saved. The fact is that, even if 1 per cent. of volatile matter should exist in bee-hive coke, it would be considered a disadvantage. The essential differences, therefore, in the two cokes is largely imaginary. In Germany and Belgium, with inferior coals to those of England and the United States, there are no bee-hive ovens, and the amount of iron produced per ton of coke, considering impurities in the ore, is authoritatively claimed to be greater than in England and the United States, a claim, however, that I have not had the opportunity of verifying.

In the modern by-product oven with improved uniformly continuous heating systems, cokes of varying degrees of hardness and inflammability can be produced in periods varying from eighteen to twenty-four hours.

The gas-retort coke made by nearly every gas company making coal-gas, is used for heating, steam-raising, and the production of water-gas, and, in London, in the cement industry. On account of its porosity and lack of uniformity it does not possess the fuel value, burned in the ordinary way, that it does burned with proper draft and special coke stoves, but grates have been constructed, and a furnace designed for burning coke with a long flame, invented by George Wilton, formerly an officer of the Gas Light and Coke Co., now Managing Director of the Chemical Engineering Company, which finds much favour with gas companies, and is capable of general application.

Application of Coke in Domestic Fires.

Sir William Siemens devised a system of burning ordinary porous retort coke in an open grate, in combination with gas, and introduced quite a number of these fires. Owing to lack of density of ordinary retort coke, I have been told, it has not found favour generally, the coke occupying nearly twice the space of ordinary coal, presenting disadvantages to the user not made up for by its advantages of smokelessness and of greater radiating power. Improved coke, of course, overcomes the objection to bulk.

The late Sir Charles Cookson, in a paper entitled "Smokeless London," described his use of gas in combination with anthracite and coke, showing conclusively the cheapness of gas for lighting fires in the place of wood, &c. Improved coke would, as a matter of course, work more effectively in this combination, which is simple and inexpensive. Grates and stoves made by several British manufacturers appear to be also well-adapted to the burning of improved coke, and from what I have seen of them in the burning of ordinary retort coke, I am of the opinion that they will work successfully. In the United States I have secured results both with ordinary retort coke and by-product coke that indicate that the physical and chemical change from raw coal to coke is a most advantageous one if the coke is properly burned. Coke in blast furnaces took the place of charcoal and pit-coal revolutionising the production of iron. I am confident that improved coke for domestic fires will revolutionise the fuel and gas industries.

The Royal Commission on the Coal Supply recommends central heating as a means of economising fuel. I beg to submit that coke fires can be kept all winter with a very small expenditure of fuel in simple central-heating systems that would keep ordinarily cold passages and rooms comfortably warm. The circulation of air in our dwellings should be as uniform as the circulation of the blood in the body of healthy persons. Nations that insist on this are neither weak or unheroic, and they have more days of real comfort than the less favoured, and are not obliged to go to the sunnier climes as frequently. Architects and heating and sanitary engineers are justified in studying this question. The Germans—those Yankees of Europe—are beginning to advise central heating on the score of economy. With improved coke and proper coke burners the efficiency of central heating systems will be

much improved. Public and office buildings, apartment houses, churches, theatres, and schools could be cheaply and comfortably heated with these central coke fires. The question will naturally arise, will the change of fuel—raw coal to improved coke—overcome poor grates, badly constructed chimneys, &c.? No, but those interested in selling improved coke should be sufficiently interested—and will be—to render assistance in remedying any conditions unfavourable to the burning of new fuel.

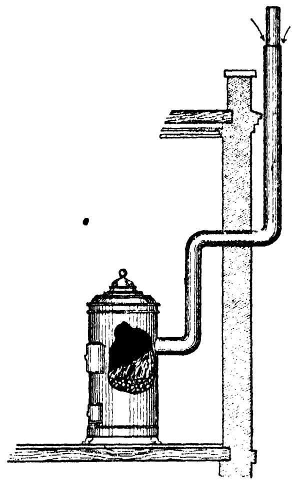
New Method of Combustion.

I shall now touch upon a new method of combustion, the principle of which I have suceeded in applying to chimney improvement and to coke-burning devices, and is also readily applicable to kitcheners, grates, steam boilers, and locomotives for improved coke utilisation.

In 1894 I made the discovery that in the accepted theory of chimney drafts certain factors had not been taken into account, for I had produced results regarded as paradoxical in view of Péclet's theory, the law of diffusion, and Tyndall's classic experiments on the diathermancy of air. My presumption was rewarded by prompt rejection of the Patent Office of my application for a patent on the ground that a patent cannot be issued to an inventor for "what to him is purely speculative," but that if I could establish my proposition by the testimony of disinterested experts or make a demonstration at the Patent Office, I would be entitled to broad claims for a new art or process of producing combustion.

The insufficiency of the current chimney-draft theory to explain the phenomena occurring in the closed stove shown on the screen is evident. This stove, as will be seen, is connected to a round sheet-iron smoke pipe, about 6 inches in diameter, and including joints, 25 feet in length. The smoke-pipe passed through an opening in the side-wall of the building in which the experiment was carried on and extended some 30 inches above the roof where observations could be taken A tube extending about 18 inches into the smoke pipe and 18 inches outside was centrally supported in such a way that an annular space equal to about 25 per cent. of the area of the smoke-pipe surrounded this short pipe. All the joints of the smoke-pipe were carefully cemented with asbestos cement as were also the joints and cracks in the stove; the fire was started in the usual way before the lower door was cemented up. The fire burned brightly for 26 hours and the economy in anthracite roughly considering comparative

Fig. 7.



Experimental Stove.

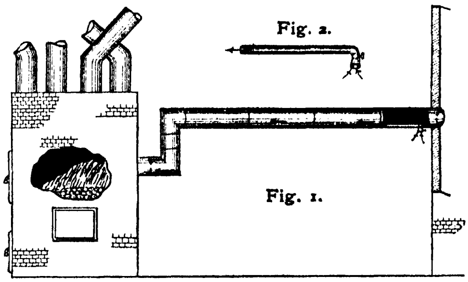
temperatures was fully 50 per cent. The observations made by me of the products of combustion passing out of the top of the short tube, and the descent of air through the annular space, indicated that experiments I had previously carried on with a small-sized cooking stove and a short chimney justified my contention that air and combustion products could be caused to flow in opposite directions in the same flue or chimney, the down-flowing air absorbing heat from the outgoing products of combustion, whereby the oxygen of the air more effectually acted on the combustible elements of the fuel in the place of combustion.

The Chief Examiner of the division of calorifics of the United States Patent Office, after witnessing demonstrations of the two oppositely moving currents, asked me to design a simple apparatus to carry out my process in his furnace.

The drawing I now show on the screen is a representation of Mr. Steward's hot-air furnace, which required one ton of coal per week prior to the application of the little air-tube to carry out the new principle I had discovered. This quantity of coal thereafter sufficed for 32 days to keep the house warm. This test was followed up by a number of others which convinced Mr. Steward of the validity of my claims. Mr. Steward's high standing as an

engineer and patent expert proved a great boon to the new invention. Subsequently, Professor Frederick H. Hutton, Professor of Mechanical Engineering in Columbia University, and Secretary for 25 years of the American Society of Mechanical Engineers, and Professor Morton, President of the Stevens Institute of Technology, as well as Dr. George H. Benjamin, American representative of the late Sir W. Siemens, gave the invention their warm approval.

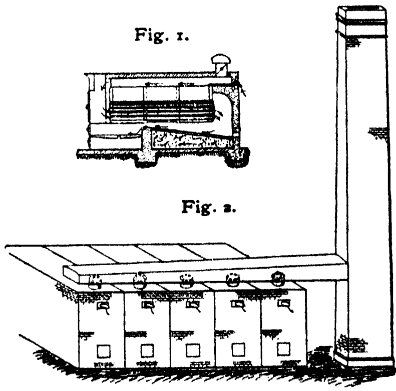
FIG. 8.



STEWARD FURNACE.

The New York Quinine and Chemical Works' boilers embody the same principle. I now show them with others to illustrate applications of the new principle.

FIG. 9.

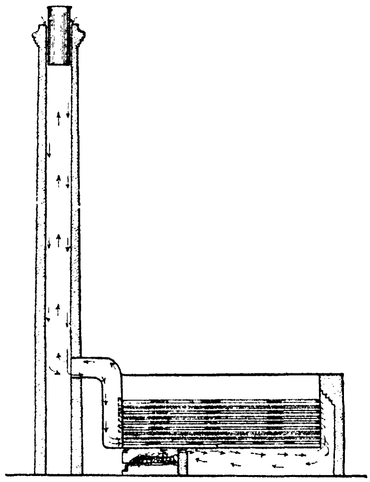


NEW YORK QUININE AND CHEMICAL WORKS.

It is perhaps due, primarily, to the late Russell Sage, of New York, who was largely interested in the gas business, and who saw in my improvements means for the better utilisation of coke for heating, that I seriously turned my attention to a study of the various systems of gas-making in the United States. But it was James W. Ellsworth, a large colliery owner, who first clearly saw the significance of the by-product oven in its relation to the gas and fuel industries, and who, after I had had to do with the testing of his coal in Otto-Hoffmann ovens actively encouraged me in going deeply into the whole question of coal distillation, and especially coke utilisation. Mr. Ellsworth personally made tests with coke for domestic heating with apparatus that I designed and estimated his saving over the best anthracite coal as reaching fully 40 per cent., proving that the supply of heated air furnished on top of the bed of fuel was even more favourable with coke than with coal.

This merely tentative experiment I followed up by a series of experiments in a laboratory I had fitted up for the purpose and in actual use for heating. All these tests show that

FIG. 10.



STEAM BOILER WITH AIR INSPIRTOR.

with my method of supplying heating air on top of the fuel instead of cold air underneath, coke, both retort and by-product, could be made superior fuels to the best anthracite.

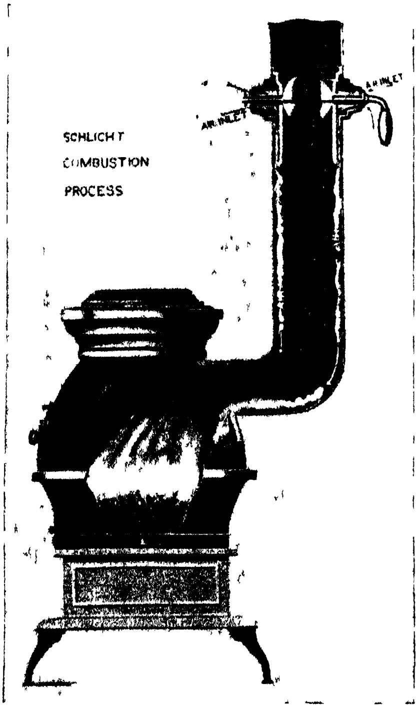
I believed, therefore, that I had achieved something that bore the same relation to coke that the gas-stove bore to gas and subsequent confirmation has been recently secured.

In kitchen stoves there is a great waste of coal. They also make their full share of smoke. The gas-stove has greatly obviated these fuel wastes, but in millions of homes raw coal continues to be used. The improved coke I have described if burned properly should produce not only greater economy, freedom from smoke, but also higher efficiency, particularly with this new process of combustion which is well adapted thereto. For the homes of the poor and those

who cannot afford the luxury of open fires my process will save fully 50 per cent. in fuel in ordinary stoves. In the burning chiefly of anthracite in and about New York there are some thirty thousand installations of apparatus embodying my principle.

I have frequently but reluctantly accepted invitations to read papers dealing with the use of coal from learned and inquisitive bodies in the United States—papers designed chiefly to

FIG. 11.



COKE AND ANTHRACITE STOVE.

promote discussion and question-asking—a highly developed American trait as some of you are doubtless aware; but in undertaking the task of reading a paper before the Society of Arts, whose audiences are wont to be addressed by men of rare gifts and deep learning, I have had grave fears indeed, lest my humble and unconventional efforts might suffer too much by comparison with more exhaustive and scientific discourses. But, supported as I am by warm friends and the enthusiasm of conviction, I feel both bold and strong in my zeal for the cause I am advocating, and I unhesitatingly predict that within five years the logic of events will bring about such reforms in the use of coal, that England instead of being the most spendthrift of nations—considering her coal supply—will reach the highest economic standards and provide the spectacle of a "Smokeless London."

FIG. 12.

CENTRAL AIR-HEATING COKE FURNACE.

I desire to express my heartfelt obligation for the courteous treatment and broad-minded encouragement I have received from Mr. Corbet Woodall, Governor of the Gas Light and Coke Company; Mr. Watson, the General Manager; Mr. Goulden, the Chief Engineer; and Mr. Goodenough, the Chief Inspector; also to Herr Paul Liebert, of Berlin, Managing Director of the Oberschlesische Kokswerke and Chemische Fabriken Actiengesellschaft, and Herr Altpeter, Local Director of the Zarbze Works; to Monsieur Brichant, Managing Director of Evence Coppée; F. J. Collin, Dortmund; and Directors Holbeck and Schmach, of the Actiengesellschaft für Kohlendestillation, Gelsenkirchen, for the privilege accorded me of testing coals in their ovens.

DISCUSSION.

Dr. J. S. OWENS, in opening the discussion, said he was particularly interested in that part of the paper which dealt with the device for improving the combustion in closed stoves. He gathered that the device was

applicable only to closed stoves, and to the combustion of non-smoking fuel. With reference to central heating, he thought there was some little difficulty as to whether it was an advisable thing or not. When a building had to be heated, it was not quite the same thing as heating people in the building. If one went into a building which was heated with warm air, one very often felt quite cold, although the temperature might be 60° or 65°, and the reason of that, he had no doubt, was because the heat was lost to the walls. Although the air of a building might be heated perfectly, the effect was not satisfactory to the individual. He thought one reason was that the convection of heat by air to the human body was extremely slow. The point was to compare that by heating with radiation by an open fire. When one sat by a fire which was radiating a large quantity of heat, one got hot very quickly. Another difficulty was the drying effect which central heating had on the heated air. It was also difficult to find a basis of comparison between the two systems; that is on what basis could they be compared? He would like to ask the author if he had any idea upon the point, because he found some difficulty in that connection when carrying out tests for the Coal Smoke Abatement Society. One basis of comparison which he had adopted was the cost—and everything boiled down in the end to cost in most countries—the cost in pence, per hour, per degree of rise F. in room air. He referred to domestic heating. He had some figures in his possession which were derived from those tests carried out for the Coal Smoke Abatement Society, under the superintendence of Dr. Des Vœux, and some interesting results were arrived at. In gas-stoves, stoves which had no flue, and in which all the products of combustion were passed into the room, the cost was an average ·095 of a penny, and in gas fires which had flues the cost was ·11 of a penny. On the same basis, with coal fires in open grates the cost was ·026 of a penny, and coke fires in the same grates ·037 of a penny. The figures must be considered as merely approximations; they varied slightly with different grates and fuels; but they gave a fair idea of the relative costs. He thought one of the difficulties with any smokeless fuel was that it was to a great extent flameless, and it was known that the amount of radiation from a luminous flame was very considerable. If one took away all gaseous matter from the coke, one took away all the matter which produced a bright flame, and a bright flame undoubtedly did produce a great amount of heat. That was one of the points that came out in the tests, namely that a fuel which produced a bright luminous flame heated up a room in an open fire much quicker than one which did not produce a luminous flame. With reference to the new method of combustion, that to him was one of the most interesting points in the paper. As the author said, it looked contrary to the result of what one would expect from a physical point of view, but he had no doubt that it was the cold outer surface of the flue which permitted of the down draught. He particularly desired to know the basis of comparison between the two systems? He knew there were numerous pitfalls. For instance, he had tried comparing fires upon the basis of the amount of heat given to the air; measuring the amount of air passed through the room, taking the temperature, and finding the amount of heat from the specific heat of air; but it happened that even if one doubled or trebled the quantity of air it did not reduce the temperature of the room, which was rather a remarkable result. He should like to see, if the author had them, the results of some comparative tests on stoves fitted with the apparatus and without. From the point of view of smoke he thought any suggestions which tended towards its abolition deserved very serious consideration, because it was one of the most crying evils of the day.

Mr. Greville Jones said he was interested in the paper more from a metallurgical point of view; what he wanted was a good metallurgical coke from which pig iron could be made. The author had brought forward a problem which he thought all citizens of London ought very seriously to consider. From a metallurgical point of view, there was no reason why all the gas necessary for London should not be produced in a by-product oven, and why, by producing gas in by-product ovens, London should not get an extraordinary credit from those by-products in the shape of sulphate of ammonia, which could be used for agricultural purposes, benzol, tar, &c., which were extracted out of gases. It seemed to him that there was no reason why coke made by that process should not be used for household purposes, in which case the atmosphere above London would be very much cleaner.

Mr. A. H. Louis said the methods the author had brought forward were not unknown in this country. Two or three years ago a person, whose name he had forgotten, brought to London a method very similar to the author's for use on tall chimneys. As explained in the paper, the reversal of draught could not be obtained in tall chimneys without a suction fan or similar arrangement. This gentleman, to get over the difficulty, had a mechanical contrivance for use in the top of the chimney. The arrangement apparently worked very well as long as the inventor had charge of it, but in other hands it did not; the stokers did not do their work properly, and the economy ceased. With regard to the author's arrangement, it seemed highly probable that drawing in the air from a small pipe would be sufficient; he had got a very large chimney to give the necessary draught. In ordinary slow-combustion closed-in stoves, such as were used in country houses, in which coke or any slow burning material was used, if every door in the stove was shut air came down the chimney.

It was a very slow process, and that was what was desired, and was exceedingly economical. That was without any particular arrangement at all, and sometimes—he had a case within his knowledge—when the pipe in the wall became rusty a better effect was obtained than when the pipe was not rusty, and that was unintentionally approaching very much to the arrangement of which the author had spoken. Therefore, for small stoves at any rate, it seemed as if the author's method was an exceedingly good one. Everyone knew perfectly well that if England were to accept American, French, or German practice for heating houses, any coke or anthracite, prepared by any method, could be used. As a matter of fact, a certain member of the House of Commons had suggested as a municipal enterprise that coke ovens should be built in a coal district, and that the gas should be brought direct from the collieries to London for heating and lighting purposes, which was scarcely a feasible idea. As the author had given such a good *résumé* of the origin of coke ovens, he would like to point out that probably the first coke oven for recovering by-products was erected in 1769, at Saarbrücken. Strangely enough, the poet Goethe, has also mentioned the furnace, and was much struck by the fact that there was a place where there was an oven, and that coal was being used, and that oil and gas was being separated from it, and, what was more, soot was being separated from it. The people in that district, which was a colliery district, sold the tar for lubricating purposes, and also the oil for use in lamps, and the soot for lamp black; but as there was no market for those things, the practice was abandoned. He had heard of a rather good experience in colliery practice in one of the collieries that the German Emperor wanted to purchase, in order that the German Government should have their own supply of coal. At the Shamrock Colliery they had two sets of ovens. That colliery had a very big by-product recovery installation, and also another which they were using under their boilers, and they came to the point where the cooling effect on the gases cost more than the by-products were worth, that was to say, in certain cases it was cheaper to take their hot gases direct from the ovens than to wash out the by-products. The point was that probably they were using poor coal.

Dr. H. A. Des Vœux rose to speak as a member of the Coal Smoke Abatement Society. The first photograph shown on the screen was of very great interest to him, because it was a similar condition of affairs which first made him take up the question of trying to abate the smoke evil in London. He was an early riser and had observed the condition of the atmosphere of London at four, five, six, and seven o'clock in the morning. It was most extraordinary to see the difference in the atmosphere between the hours of five and nine. At seven o'clock the atmosphere was extraordinary clear, especially in the summer, but at eight o'clock it was never clear. He joined the Coal Smoke Abatement Society at its inception some eight years ago, and he had been working on the subject ever since, more or less satisfactorily. He confessed that it was with the greatest satisfaction that he noticed that societies in London other than the Coal Smoke Abatement Society were now taking up the question. They, as a society, believed that the question only wanted to be tackled by a scientific man to be dealt with summarily for ever. It was only a question of chemistry and engineering combined to get rid of smoke in London, and surely the chemists and engineers of London were not going to be beaten by what really was a fairly simple problem. The burning of crude coal had been condemned for years, but still it went on; and he could not help feeling that the discussions which had taken place with regard to the subject would lead to more success than the Coal Smoke Abatement Society had itself been able to achieve. That society was not a scientific society; unfortunately they had been unable to engage the sympathies or exertions of the scientific world. He thought, however, the scientific world would take up the subject, because they would see that there was money in it. Money, he was afraid, governed people always, and fortunately he thought money would be on their side in the matter. There was an enormous fortune for anyone who could make fuel which would burn smokelessly in an open fire. He had had any amount of letters from inventors, offering him half-profits in inventions if he would sink money into them; but he could not do anything, as in the first place he could not afford it, and in the second place, if he could his position as a member of the Coal Smoke Abatement Society would be immediately compromised. It would not do for them as a society to have an interest in any particular process. He believed in the future there would be many processes carried out; but his society could do nothing more than report upon them. He did not quite understand whether the author's process was quite applicable to the open domestic grate; he rather took it that it was not. He was also perfectly convinced, from what he had seen, that in his lifetime, at any rate, people would stick to the open grate. He himself had had an almost closed anthracite grate in his dining-room for the last eight years. It was ugly, but it was very economical. It cost him no more than 2½d. to keep burning for 24 hours, and the chimney had never been swept since he had had it in the house. But he could only get two or three to follow his example. If the author's process was only applicable to closed grates, he did not think that he would get many followers in Conservative London. The author said his method was going to produce a better coke. He (the speaker) knew Sir Charles Cookson very well. Sir Charles was always preaching coke. He had seen coke fires, and they were very nice fires in their way, but they were not so nice as coal fires. He

did not think Sir Charles Cookson got anyone to follow his example. For some reason or other the people in London did not like a coke fire; whether it was the fault of the coke or the open grate he did not know; but he did not think the ordinary coke, as supplied by the gas companies at the present time would be used as fuel in London fires. He would be very glad if the author could say whether his new coke would be more applicable to the open grate than the coke of the past. He believed the gas companies could manufacture it, if they would try, but it was only in the last few years that the companies had been so trying. He approached one of the largest gas companies many years ago to try and interest them in the subject, but he failed. He said he wanted a smokeless house and asked the company to help him. They shook their heads and told him to burn gas. He said he could not afford to do that, and asked if there was no alternative? They replied that there was none. He hoped that the gas companies would, by force of competition, be driven to supply a new fuel, which would result to the advantage of themselves and to the City of London.

Mr. PAUL SCHLICHT, in reply, said he would answer in a few words Dr. Des Vœux's point as to the applicability of his process to open grates. Bituminous coal could be burned by his process in an open fire with certain modifications. The descent of the air was due to the fact that a vacuum was produced in an open grate. He had carried out experiments, and he could say roughly that fuel could be saved and smoke stopped, but he did not believe in the use of raw fuel, and the tests he had made in the United States had been chiefly made with anthracite coal and by-product coke, which he believed in. By-product coke, as made in the United States by companies that were supplying various cities with gas, produced a brighter fire than any fire he had seen in London, because of the fact that all the gas was not eliminated. As he had mentioned in his paper, metallurgical coke in the best ovens, at the present time, required twenty-four to twenty-eight hours to make, and domestic coke was being made in eighteen hours. That domestic coke had from 3 per cent. to 7 per cent. of volatile matter, chiefly hydrogen and certain hydro-carbons. The colour of the flame was not dirty; there was no dirt about the room; and one's face and collar did not get black. He had studied the tests made by the Smoke Abatement Society, which had been mentioned by Dr. Owens, and he was much impressed with the care with which they had been conducted. They had, however, been made along entirely different lines to the tests he had made. For instance, when the process was tested as to the amount of fuel that could be saved, either coke, by-product, or retort, thermometers were placed in eight different rooms of a house, and readings were taken every 15 minutes; the temperature of the outer air was also taken, and those results were compared with other tests without the device. The different local companies then went boldly forth, and said they would put the thing on a rental basis of so much a month, and if it was not found to be satisfactory it could be returned; and 97 per cent. of the installations put out on approval had been paid for. The man who occupied a room knew whether he was getting any benefit or not better than any thermometers could tell him.

Dr. DES VŒUX asked whether that applied to closed stoves.

Mr. SCHLICHT replied that it was a warm air heating apparatus, central heating. But he was well aware of the fact what an important matter it was to be able in England, where people liked to poke fires even if they were smoky, to produce a system that would effectually cure every chimney top; and from experiments he had made he was certain it could be done, but he did not wish to divulge further, as those matters were the subject of applications for letters patent. He had spent a good deal of time studying the question in this country. He made bold to say that bituminous coal, and by-product coke could be burned by the process by means of a slight change, not in the grate, but in a portion of the open fire, with a small device that would not cost, when made in large quantities, more than a smoke-jack that was now placed on top of a chimney. Experiments so far in the United States with a certain size of chimney gave great promise of that being a general success, but chimneys varied in sizes; some chimneys were made in Rumford's days to accommodate a good-sized sweep, and he did not know whether he would be successful in applying his system to such as those. With regard to by-product coke, bituminous coal, and anthracite coal, he had for three years carried on careful thermometric tests; not merely laboratory tests, but tests in the houses of leading citizens, physicians, physicists, and mechanical engineers, and he had not found what Dr. Owens had said was the case. It might be that the air was different in America. People did not get cold in a room that was properly heated with the right kind of heating appliances. American houses were very comfortable. By-product coke was the coke that gave the best results; it might be made a clean-flaming fuel. The very best anthracite in the United States—free burnt anthracite—flamed, but it was not a dirty flame. Why was it that iron-masters made a hard, concentrated coke, driving out the volatile products? They got more heat with that than with a coke that had 5 per cent. of volatile matter in it. It was so in a central heating stove; it was so in an open fireplace if the fire was once started with a by-product coke even without any gas in it. Those were practical results which had been

attained in the United States. No one there would think of using soft coal in an open fire; Americans were Anglo-Saxon enough to have plenty of open fires. They had open fires in every room, but they were auxiliary to a central heating system. They were ornamental, and were not relied upon for heat. He never found that he could stand 10 or 15 feet away from an open fire and get warm. He had been in England now for four months and had had already three attacks of influenza.

The CHAIRMAN, in proposing a hearty vote of thanks to the author for his extremely interesting paper, regretted he was not an expert on the subject, and he had only taken the chair in the absence of Mr. Corbet Woodall, who was to have presided, but who had telegraphed regretting that, owing to doctor's orders, he was prevented from being present. He (the Chairman) probably knew less about the subject than anyone present, but he did know enough to be aware of the enormous importance of it with regard to the health of the present and future generations. The thing that struck him most, apart from the suggestiveness and eloquence of the paper, was the rather sanguine expectation which the author had put forward, that five years would suffice to convert England to better ways. When he mentioned that the author, in his own paper, showed that the objections to bituminous coal and the attempts to make a decent substitute by coking began 270 years ago, it would be seen what progress had been made. Another point was that the author referred to the remark of Sir William Siemens that in his opinion, under no circumstances ought raw coal to be used. He (the speaker) however, presumed that our ancestors began with raw meat, and it must have taken very many generations of men to find out that there was any advantage to be gained in cooking meat; probably the first people who discovered those advantages were burned; and one might be quite sure that there were learned men in that time who thought society would go to pieces if meat were cooked. Apply that same theory to the use of raw coal. It had taken a great many years to arrive at the present point, and he was afraid that five years would scarcely suffice for the regeneration of coal fires. He thought it quite probable, however, in regard to industrial purposes generally, that the advantages of the author's system were easily observable; but in regard to the domestic hearth the author had to fight a tremendous prejudice. One gentleman that evening had spoken about the Englishmen who loved their open grates. He (the speaker) thought that if he had said English women, it would be more to the point. It would be very difficult to get English women to accept anything but an open grate. Consequently the line of least resistance was probably that suggested by one of the speakers, and accepted by the author, that of having an open grate with an improved fuel.

The vote of thanks was carried unanimously.

ARTS AND CRAFTS.

Wall and Ceiling Decorations.—The change that has come over the character of wall decorations of recent years must be apparent to the most casual observer. The difference is not merely in the kind of designs in vogue, or in the distribution of the ornament — though in both of these it is marked enough—but in the very materials employed. "Once upon a time," as the saying goes, it would have been safe to take it for granted that the ordinary middle-class house would be papered throughout—with the exception, perhaps, of distempered walls in the kitchens and servants' bedrooms, and a tiled dado, possibly, in the bath-room. To-day it would be dangerous to assume anything of the kind. It is not that wall-paper at any rate (whatever may be the case with old-fashioned distemper) is not largely and indeed universally employed. It is still, of course, the staple wall covering; but, not only have the different kinds of paper increased in number, but they have been supplemented by various other materials, either new in themselves or only recently used for wall decoration. Only a few years ago, to find the passage walls of a London theatre covered with coloured linen or canvas would have created quite a sensation, and the idea of a coarse canvas dado, painted and varnished, would have met with an almost derisive reception from most people. Yet neither of these things so much as calls for comment to-day. We take them as a matter of course.

Self-evident as the change is, it was none the less somewhat of a surprise to visit the Building Trades Exhibition at Olympia. The show, in its new quarters, was on so much larger a scale than it had ever been before, that it afforded a far better opportunity than usual for the study of what is being done in the way of trade decoration. Perhaps the most noticeable thing in the whole Exhibition was the apparently never-ending variety of materials for decorating the walls and ceilings of houses. The first thing that strikes one about the numerous paints, &c., is the ugliness of their names which are chiefly formed from some quality they are supposed to possess with the aid of a suffix. Still the quality of the names pales before their quantity. Time was when enamel paint, to the unitiated, at least, seemed to be synonymous with Aspinall. To-day we have a whole collection of different makes, to say nothing of ordinary paints in goodly number, and a formidable array of water paints and washable distempers. The makers of these last have shown their enterprise at the Building Trades Exhibition. Messrs. Sissons (who make Hall's Washable Distemper) erected a bungalow which they decorated entirely with their various paints, and the Silicate Paint Company, not content with covering the inside and outside walls of a model cottage with "Duresco" have shown numerous specimens of hand-painted decoration executed in their paint.

Additions have also been made to the more durable

kinds of wall coverings. Anaglypta and Lincrusta (neither of which, by the way, had a special show at the exhibition) are, of course, quite old friends. The various sorts of metal decoration are of more recent invention. Messrs. Essex and Co. are now producing an enamelled metal wall covering, and the "Emdeca" decorations, enamelled on zinc sheets have been with us now for some ten years. At the present time, instead of confining themselves to simple geometric tile-patterns, the makers are producing all kinds of floral and other designs. Their effect in the distance is rather puzzling. As a rule there is something about a design which reveals the process by which it is executed—one knows more or less instinctively that a certain pattern is executed in tiles, say, or in wall-paper—but there is a want of distinguishing character about these enamelled metal designs, which makes it difficult to guess what they are for, while the surface of the material, not quite like either tiles or varnished paper, again does not help us. A new departure introduced by the "Emdeca" Company is the "Steleonite" stamped steel ceiling decoration. This is made of Bessemer sheet steel, stamped with patterns in relief, and is intended to take the place of plaster ceilings. Of course, the effect *in situ* is not quite the same as that of a plaster ceiling—but the material in its own rather different way gives all the relief that is required for the purpose. It is claimed that these various metal wall and ceiling coverings are now quite simple to fix, aud that when properly put on, they keep their position for years.

There was not a very representative collection of wall tiles at Olympia. Messrs. Mintons, Limited, had a small exhibit of enamelled tiles, and Messrs. Carter and Co. showed some wall panels, while the sides of Messrs. Doulton's bath-rooms were covered with plain coloured tiles of not unpleasing colour, surmounted in one case by a landscape frieze. The other well-known tiles firms were unrepresented. Glass tiles, however, which are a much newer form of wall decoration, and not so well known—which have, in short, their way to make in the world, were comparatively speaking much better represented. One firm, the Hygienic Glass Tile Company, Limited, showed some really very ambitious work in the way of panels made up of six-inch tiles painted with birds, landscapes, &c. Some of those painted under the glass are very interesting and suggestive in effect. Taken on the whole, however, the quality of the surface of the glass tiles is at best unpleasing. That may be because we are not yet properly accustomed to it.

To see so many media for wall decoration mixed up more or less indiscriminately with woodwork, metal casements, kitchen ranges, sanitary appliances, or what not, is somewhat bewildering. It is difficult to disentangle them and to compare their respective merits. For all that they leave the careful observer with a distinct impression that crude, banal, unsatisfactory as some of them may be their general artistic level is higher than it was some years ago.

Fireplaces.—Some wiseacres are never tired of telling us, if not that "there's nothing new and nothing true and it doesn't signify," at least that there is no such thing as a really new fashion—that fashion, like fortune, simply turns her wheel, and in so doing brings us—not to something new but to something different from what we have just been looking at. And, however much we may resent being told so, we cannot deny that there is more than a grain of truth in what they say. At the present time it is being exemplified with regard to fireplaces. Ten years or so ago it was pretty generally taken for granted that the old iron fireplaces had gone never to return. (In many if not most cases, of course, the skeleton of the surround was still made of metal, but that only served as a kind of framework to the tiles which, from a decorative point of view, made up the fireplace) Of course in one sense they have altogether departed. We no longer see small houses with heavily ornamented iron grates (though, by the way, gas stoves have a good deal of not very beautiful ironwork about them sometimes) which want continual blackleading to keep them in good condition, and look singularly out of place in summer filled with art screens or beribboned pots of flowers instead of with coals. We are not likely to see them. The inhabitant of the small house has no time to spend on cleaning such things, since he (or rather she) has learnt that tiles may be much prettier, and are certainly much easier to keep in good order. For all that, in another quarter, and in a somewhat different form, iron fireplaces are again making their appearance—and that not as a new departure, but as a part of the general movement towards Georgian decoration. There is very often a good deal of trouble involved in fitting and arranging the tile surrounds of fireplaces—and it is natural that the metalworker should not let so large a portion of his business fall unreservedly into the hands of the tilemaker without a sturdy fight to recover lost ground. Some years ago, he hit upon the happy idea of reproducing the old Georgian fireplaces (slightly adapted, of course, to fit the new grate shapes) not, indeed, in steel but in iron brought to a steel finish. The production of these metal fireplaces has gone on growing, and quite a number of them were exhibited at the Building Trades Exhibition this year. They are practically all reproductions of old designs, but they are many of them very tasteful—notably those shown by the Carron Co.—and when properly polished, look both attractive and dignified. It is only after some reflection that one realises how much keeping bright they would take, and how impossible it would be to adopt them in any house not carried on with a certain amount of style, and an ample staff of servants.

Again, in this section, the tilemakers were not very much to the fore at Olympia. Of course, there were a good many tiled surrounds, hearths, &c.,

included in the shows of the various grate makers, but the only manufacturers who show independently are Messrs. Carter and Messrs. Doulton. This last firm exhibit one adaptation to this purpose of their Carrara stoneware—a substance which has hitherto been used chiefly for outdoor work. Their small mantelpiece in coloured salt glaze stoneware is also an interesting bit of work. On the whole, however, there is very little that is fresh in the way of tiled fireplace decoration.

If we somewhat extend our field of vision and include the overmantel in our estimate of the effect of the fireplace, the most noticeable feature in this year's exhibition was the number and tastefulness of the wooden mantelpieces. Not the least satisfactory of these are those with simple, rather rigid outlines, and into some of them simple inlay work in the form of a border has been introduced with results as pleasing as they are unpretentious. The restraint and repose of some of the mantelpieces and overmantels at Olympia was really a very welcome change from the rather fussy erections of which we have all seen so many of recent years.

CORRESPONDENCE.

THE PROTECTION OF SEA SHORES FROM EROSION.

I should like to draw attention to some groynes about to be put in at Roedean, near Brighton, for the Brighton Sewers Board and the East Sussex County Council. These bodies have selected a type of groyne which, in my opinion, fulfils all the requirements mentioned by Mr. Carey and also Professor Boyd Dawkins. It is a low groyne, is easily raised as the shingle accumulates, costs under 20s. per foot run according to the accepted tender, and is composed of an immensely strong and practically indestructible material, *i.e.* ferro-concrete, or reinforced concrete.

The piles are 16 inches square, grooved on two sides, placed about 5 feet 6 inches apart, and in the grooves are placed slabs of ferro-concrete 6 inches thick, each slab being 12 inches high; these are dropped in the grooves as the shingle accumulates, and the groyne requires raising; the higher piles will be supported by struts of the same material as the piles and slabs, and being much heavier than wood, there is no tendency to "lift" with the waves. The cost per mile of coast for these groynes is, approximately, £5,000.

One of the chief advantages being that the first cost will, in all probability, be the only cost, as the material hardens with age.

As regards the binding quality of the sea-grasses on the shores of Lord Montagu of Beaulieu's estates in Hampshire, I can speak from unfortunate experience, having been almost drowned by entanglement with them whilst bathing, near Calshot, some years ago. I can strongly recommend their cultivation on a sandy coast liable to erosion.

ROWLAND H. HALLS.

Lewes, Sussex.

There are many statements in Mr. Carey's paper with which I am unable to agree, and as accuracy is of the first importance in dealing with such a subject, I will refer briefly to some of these. Mr. Carey states that "the Woods and Forests Department have control of the foreshore." The Crown Lands Act of 1886 transferred the control of the foreshore from the Woods and Forests Commissioners to the Board of Trade.

Turning now to Mr. Carey's reference to changes in the relative level of land and sea, I will not go further than to say that the existence of the Continental platform is evidence of an almost universal rise of sea level, or subsidence of the land, so overwhelming as to be beyond dispute.

Now as to the explanation offered by Mr. Carey, I refer to the locking up of ice at the poles. A short consideration will show that this is inadequate. As long as the ice is floating, its existence will have no effect on the sea level, since when melted it would simply supply the same amount of water which as ice it displaces. We are, therefore, limited to land ice. I have calculated roughly that if the ice on all the ice-bound land in the world (assuming also an ice-bound Antarctic continent) were melted, for every foot of ice we should get a rise of sea level of 1-18th of an inch. To account for a rise of 600 feet in sea level, to cover the Continental shelf, we should, therefore, require to melt such a sheet of ice of about 24 miles in thickness, which I think is rather more than was available. We should remember that since ice melts under increased pressure, there is a limiting thickness beyond which ice cannot exist. It is interesting, however, to note that the evidence of recent Arctic and Antarctic explorers shows that the ice at both poles is now rapidly melting, so that we must now be experiencing a steady though slight rise of sea level, due to the water from this melting ice.

As to there being no other explanation of a great rise of sea level, it is far more probable that the rise was due to some sub-oceanic disturbance resulting in an elevation of a large area of the sea bed.

Turning now to Mr. Carey's diagram illustrating what he calls the "normal line of travel of a particular pebble on a beach," he says the pebble is driven up obliquely to the shore line by the impact of oblique waves, but returns in a path at right angles to the shore line, thus repeating an error made by Wheeler, and some others. The mistake lies in the fact that the path of the pebble's return is not at right angles to the shoreline, but oblique. When a projectile is thrown

through the air, it describes a path which is practically a parabola; the horizontal motion being uniform, or nearly so, and the vertical being retarded or accelerated in proportion to the square root of the height travelled through. Similarly with a pebble driven obliquely up an inclined place, such as the shore. The oblique motion may be resolved into a component at right angles to, and one parallel to the shore; the former is gradually destroyed and reversed by gravity, the latter continues, being merely retarded by friction. The same law which governs the flight of a projectile, governs the path of the pebble, the component at right angles to the shore being retarded, or accelerated as the square root of the height the pebble rises or falls; the alongshore component remaining nearly uniform. The only difference being that for g, we have $g \sin i$, i being the angle of inclination of the slope; and for air resistance and friction, we have friction on the bottom.

Relative to sea-walls, I can only say that a wall having a vertical face, such as Mr. Carey recommends, would, in my opinion, be a serious menace to the shore. It is the almost universal experience of sea-defence engineers, that a vertical-faced sea-wall on the foreshore scours away the beach by the recoil of the waves from the face. Such walls are, therefore, when used for sea defence, practically always built with a curved or stepped face. The latter is, in my opinion, the best form.

Relative to groynes. There are sound methods of extending beyond low-water mark other than those described in the paper. I may say that having tried sheet piling I found it most unsuitable. My firm have extended groyne successfully beyond low-water mark by using weighted panels sliding on iron piles, the panels being composed of timber and reinforced concrete. The type of groyne we now use is made entirely of ferro-concrete and can be extended beyond low water. It is a development of the "Case" system and does not decay like timber, and unlike concrete is capable of easy adjustment to the varying level of the shore. I mention this as it has not been referred to in the paper and in order to bring the matter up-to-date. Ferro-concrete is, in my opinion, the material of the future for groynes. I explained its application very fully in my evidence before the Royal Commission.

Turning now to Mr. Carey's remark that a three or four knot current is capable of moving "normal sea sand"—a three knot current has been shown to be capable of moving flints of ten cubic inches, and a four knot current would certainly roll along boulders four to six inches in diameter. As a matter of actual experiment a current of 0·6 of a knot will move sea sand.

The references to the "Case" groynes are, I think, somewhat misleading. Mr. Case was the pioneer of the *low* system of groyning; the method of fixing the piles in the foreshore was not always that described, but was varied to suit the shore. The essential points in the system were the construction of long, low, adjustable groynes. I am very pleased to note that the author has paid Mr. Case the compliment of adopting his system, only the minor detail of the method of fixing the piles being changed. As to the necessity for extending groynes to high-water mark, this was early recognised, and very many "Case" groynes were so extended. Mr. Case certainly revolutionised the methods of sea-defence engineers in this country.

There are many points in the paper with which I am in entire agreement, expressing as they do some of the well-known rules relating to sea-defences. The subject is an extremely important one, and the necessity for soundness of theory, and an unbiassed statement of facts, as far as known, must be my excuse if I have appeared hypercritical.

JOHN S. OWENS,
M.D., A.M.Inst.C.E., F.R.G.S.,
Member of the Research Department of the Royal Geographical Society.

Mr. CAREY writes:—With regard to Mr. Rowland Halls' remarks on armoured concrete groynes for Roedean, I note that these are about to be erected. They have not yet been actually built. The application of concrete to varying purposes has been so habitual with me that I have heard it asserted that I should be seen someday carrying a concrete umbrella. Armoured concrete is a material I am now largely adopting. Mr. Halls does not state how the concrete planks or panels he proposes to use are to be secured to the piles. The piles will have to be driven on a rough beach and in a tideway.

I have read Dr. Owens' notes with interest. In one or two particulars he has rather missed the points I was trying to make. I do not, of course, dispute the evidence of the Continental platform, but I gather Mr. Reid's contention to be that, at an approximately defined date (about 4,000 years ago), the relative levels of land and sea resulted in a general coast line, apparently about 60 feet lower than exists to-day. I think we want much stronger proof than has yet been forthcoming, before this can be asserted with confidence.

The assumption of a rise of sea level on an enormous scale (such as 600 feet), to cover the Continental shelf, appears to me highly problematical. A local lowering of land level would be far more likely, and either assumption would fit the facts.

With regard to the travel of a pebble along a beach, the explanation offered in my paper was in general terms, and is, I believe, correct. The action of gravity will, of course, modify the oblique motion, causing a slight curvature in the path of the pebble, as it is forced up the beach. The return of the pebble, however, is certainly at right-angles to the foreshore, as the lateral forces acting on it have ceased to exist, and the pebble has momentarily come to rest, at its highest altitude.

If Dr. Owens refers again to my paper, he will see that I laid particular stress on the effects of underscour on a sea-wall and the resolution of wave impact, on a vertical faced wall, into vertical components, upwards and downwards. Instead of trusting to an ornate and expensive section, I bring shingle and reinforce the cheapest possible form of wall, with the defence Nature provides.

Laboratory experiments on the velocity of a scouring current are apt to be misleading. When smooth sand lies at some considerable depth, a current of high velocity is required to create scour. The dislodging of sand particles from a sea-bed depends more on local agitation than on the action of horizontal stream lines. The velocity of current capable of moving boulders of 4 to 6 inches diameter would depend on what the boulders rested upon. Dr. Owens does not say how sheet piling of groynes, below low water, fails. I have used it with complete success.

MEETINGS OF THE SOCIETY.

ORDINARY MEETINGS.

Wednesday Evenings, at 8 o'clock:—

MAY 15.—"Trypanosomiasis or Sleeping Sickness." By HERBERT W. G. MACLEOD, M.D., B.Sc.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department. CHARLES EDWARD HENRY HOBHOUSE, M.P., Under Secretary of State for India, will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 13...Surveyors, 12, Great George-street, S.W., 8 p.m. Mr. Maurice L. Gwyer, "The Prevention of Corruption Act, 1906."

Geographical, University of London, Burlington-gardens, W., 8½ p.m. Lieut. Boyd Alexander, "An Expedition from the Niger to the Nile."

Medical, 11, Chandos-street, W., 8 p.m. General Meeting.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Dr. Ernest W. G. Masterman, "Recent Discoveries in Palestine and Syria."

TUESDAY, MAY 14...Asiatic, 22, Albemarle-street, W., 3 p.m. Annual Meeting.

Royal Institution, Albemarle-street, W., 3 p.m. Mr. D. S. MacColl, "Alfred Stevens (the English Sculptor and Painter). (Lecture I.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Statistical, The Surveyor's Institution, 12, Great George-street, Westminster, S.W., 5 p.m. Lord Eversley, "The Decline in Number of Agricultural Labourers in Great Britain."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. T. Holding, "The Camera at Home."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. W. L. Griffiths, "Some Phases of Canada's Development."

Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. H. Stevens, "Photographing of Flowers and Animals."

WEDNESDAY, MAY 15..SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Dr. H. W. G. Macleod, "Trypanosomiasis or Sleeping Sickness."

Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Dr. Hugh Robert Mill, "The Standard Rain Gauge, with Notes on other Forms." 2. Mr. J. W. Lovibond, "A Method and Apparatus for Measuring Fog Densities." 3. Colonel J. E. Capper, "Note on a Balloon Struck by Lightning April 11th, 1907." 4. Messrs. J. Nevin and A. S. Herschel, "Account of a Remarkable Excavation made by Lightning in Peat-earth on August 2nd or 3rd, 1906."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Prof Alfred W. Porter and Mr. P. F. Everitt, "Diffraction Rings due to a Circular Aperture." 2. Mr. E. M. Nelson, "An Improved Vertical Illuminator." 3. Exhibition of Pond Life.

British Archæological Association, 32, Sackville-street, W., 8 p.m.

Pharmaceutical, 17, Bloomsbury-square, W.C., 8 p.m. Annual Meeting.

THURSDAY, MAY 16....Antiquaries, Burlington-house, W., 8½ p.m.

Chemical, Burlington-house, W., 8½ p.m. 1. Messrs. W. Barlow and W. J. Pope, "The Relation between the Crystalline Form and the Chemical Constitution of Simple Inorganic Substances." 2. Mr. J. Hübner, "Experimental Investigation into the Process of Dyeing." 3. Messrs. W. H. Perkin, jun. and R. Robinson, "Some Derivatives of P-pyranol Allied to Certain Derivatives of Brazilein and Haematein." 4. Mr. G. D. Lander, "Mixed Semi-Ortho Oxalic Compounds." 5. Mr. J. B. Cohen, "The Mechanism of Bromination of Acylamino-Compounds." (Preliminary notice)

Royal Institution, Albemarle-street, W., 3 p.m. Mr. H. F. Newall, "Spectroscopic Phenomena in Stars—II. Motion."

Optical, 20, Hanover-square, W., 8 p.m. Mr. F. J. Selby, "The Testing of Trial Cases."

Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. Messrs. F. H. Page and F. J. Hiss, "The Present State of Direct Current Design as influenced by Interpoles."

Historical, Field-court, Gray's-inn, W.C., 5 p.m.

Numismatic, 22, Albemarle-street, W., 7 p.m.

FRIDAY, MAY 17...Royal Institution, Albemarle-street, W., 9 p.m. Mr. E. M. Wedderburn, "Seiches on the Lakes of Scotland."

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

SATURDAY, MAY 18...Royal Institution, Albemarle-street, W., 3 p.m. Mr. Arthur Bourchier, "The Limits of the Dramatic Art." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club-house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

A programme of the arrangements for the evening will be published in due course.

STOCK PRIZE.

FOR THE DECORATION OF PART OF THE INTERIOR OF A BUILDING.

The Council of the Society of Arts are prepared to offer, under the terms of the Stock Trust, a Gold Medal, or a Prize of £20, for competition amongst the students of the Schools of Art of the United Kingdom, at the Annual Competition to be held in 1908.

The Prize is offered for the best original designs for an Architectural Decoration, to be carried out in painting, stucco, carving, mosaic, or any other process.

This Architectural Decoration is to be for the side of a room or a hall, a ceiling, the apse or side of the chancel of a church, or any suitable part of the interior of a building.

The designs must be on imperial sheets. Each set must consist at least of a coloured drawing to scale of the whole design of decoration, and two coloured drawings of details on separate imperial sheets. Mere patterns or sketches of details, without the mouldings or borders necessary to make up a complete decorative scheme, will not be taken into consideration. The designs must have been made between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1893 or 1897 cannot compete again.

The designs are to be submitted, with other school work, in the usual manner, to the Board of Education, South Kensington, in April, 1908. Each of the imperial sheets, forming a set of competing designs, must be marked, "In competition for the Stock Prize," in addition to being labelled or staged according to the Regulations of the Board of Education.

PROCEEDINGS OF THE SOCIETY.

TWENTY-FIRST ORDINARY MEETING.

Wednesday, May 15, 1907; SIR WILLIAM HOOD TREACHER, K.C.M.G., Member of the Council, in the chair.

The following candidates were proposed for election as members of the Society:—

Desmond, Veterinary-Surgeon J., Adelaide, South Australia.

Graham, Walter Armstrong, The Residency, Kelantan, Siamese Malay States.
Hepburn, Arthur E., 956, Nicola-street, Vancouver, British Columbia, Canada.
Loveless, Thomas Henry, 76, Harley-street, W.
Osment, Harry Shorthose, care of British Vice-Consul, Lima, Peru, South America.
Schlict, Paul, St. James's-court, Buckingham-gate, S.W.
Underwood, Edward, Thorndon, Baldock-road, Letchworth, Herts.

The following candidates were balloted for and duly elected members of the Society:—

Coelho, Sertorio, M.A., Rua do Conselheiro No. 7, Nova Goa, Portuguese India.
Ford, James Francis, 17, Pembridge-square, W.
Gossain, Hem Chandra, Tezpur, Assam, India.
May, Theodore Martin, Assoc Am.Soc.C.E., Rooms 1745-1749, 42, Broadway, New York City, U.S.A.

The CHAIRMAN, in introducing the reader of the paper, said that Dr. Macleod, in the early part of his career, served for a few years in India in the Indian Medical Service, since when for many years he had been lecturing on and teaching preventive medicine and bacteriology, and had also instructed medical men as demonstrator and as assistant lecturer at King's College and at the London Hospital.

The paper read was—

TRYPANOSOMIASIS OR SLEEPING SICKNESS.

By H. W. G. MACLEOD, B.Sc., M.D., D.P.H. (late H.M's I.M S.).

The earliest record of this disease, which has of late attracted so much attention, was made by Winterbottom in 1803. He observed it among natives of Africa in the neighbourhood of Sierra Leone. It was noticed also at a later period in the West Indies, where it occurred among slaves imported from Africa. They were liable to be attacked some time after landing, and even after several years of apparently good health. The significant point is that all those who had the disease had come from Africa; and we now know they contracted the disease there.

Sleeping sickness is endemic in Equatorial Africa. At first it was noticed in places on or near the East Coast, and (tracing it along this coast-line from north to south) it is known that the following localities are in the zone of infection:—The Senegal River, Senegambia, Sierra Leone, Liberia, the Ivory and Gold Coasts, Upper Guinea, Biafra, the Camaroon country, the Congo, and Loanda in Portuguese West Africa.

The disease is also to be met with far inland, in Central Africa. At the mouth of the Congo it is not very prevalent, but it is very fatal all along both banks and particularly on the south side of that river. At Leopoldville, Stanley Pool, and Lukolela areas have been devastated by Sleeping Sickness. In 1900 Cook found it was present in Uganda, and since then it has extended to the shores of the Victoria Nyanza and Albert Nyanza, and also to the east and south. It is probable that Emin Pasha's Soudanese (who came from the Congo, numbering 10,000, and settled in Busoga) introduced the disease into Uganda. British East Africa, east of Kisumu, has escaped; and up to the present German East Africa has, I believe, not been infected. The disease is endemic in certain regions along the course of rivers and their affluents; the Senegal, Niger, Congo, and the Nile are specially affected; and, strange to say, villages close to one another remain quite free from infection, although in their immediate neighbourhood the death-rate from Sleeping Sickness is appalling. The outbreaks occur suddenly, and, although several members of a family may be attacked, it is usually found that, though exposed to similar conditions, all do not suffer, but only single individuals succumb. Old people do not as a rule contract the disease, those most susceptible are young children and young adults, between the ages of five and nineteen years. In some places, Uganda for example, people of all ages are liable to infection. All races are equally open to attack. Among those investigating the causes of Trypanosomiasis was Lieutenant Tulloch, of the Royal Medical Staff Corps, who was infected in Africa, and came back to die. A Frenchman died in Paris from the same cause; and both at the London Hospital and at Charing Cross Hospital, Europeans from infected districts have been under treatment. The mortality, when once the later stage of the disease is reached, is 100 per cent. In other words, recovery is unknown, although it is possible that the germs of infection may die off in the blood before they have given rise to the symptoms of Sleeping Sickness.

The spread of civilisation, the exploration of the country, and the opening-up of trade have brought before the various Governments concerned in African affairs the importance of investigating the causes of a deadly disease which has been rapidly spreading during

recent years. Portugal, Belgium, France, and Germany have all sent investigators, and have spent large sums of money for the discovery of its cause and for preventing its dissemination, if possible. It is known that in the valley of the Congo from 400,000 to 600,000 deaths have occurred from this disease during the past 10 years; and in Uganda alone the mortality has reached 40,000 to 50,000. In 1902 the British Foreign Office, in conjunction with the Royal Society, sent out a special Commission to Uganda to investigate the cause of the malady and to report accordingly. Colonel David Bruce, of the Army Medical Corps, a graduate of the University of Edinburgh, was the senior member of the Staff, the others were Captain Greig, I.M.S., and Dr. Nabarro. The work was commenced at Entebbe.

Shortly after the arrival of the Commission, Dr. Castellani, not a Member, was the first to discover a parasite known as a trypanosome in the spinal fluid of five persons infected with Sleeping Sickness; and also in the blood of one of these cases. He suggested that a micro-organism classed as a diplococcus was the cause of the disease, and not the trypanosome. The statement has also been made that he "put forward the view that the trypanosome was the essential cause, and the diplococcus a secondary infection of great importance in the disease." Further researches showed that the trypanosome was to be found in all cases of Sleeping Sickness and also in the blood, though not in the spinal-fluid, of a certain number of persons residing within the infected area in Uganda. These individuals, however, showed no symptoms of the disease.

Colonel Bruce had previously discovered the cause of the tsetse-fly disease among horses in South Africa, and known as *Nagana*, to be a trypanosome in the blood of the infected animals conveyed by *Glossina morsitans*; and he traced the source of infection in Sleeping Sickness to the fly known as the *Glossina palpalis*, a species of the tsetse-fly. To quote his words, "We found the distribution of the disease to be most peculiar. It was confined to a narrow strip of land running along the shore of the lake and to the many islands which dot the northern shore of the lake. It was thought that this peculiar distribution must depend upon some peculiar factor and that factor we found in the *Glossina palpalis*." The distribution of this fly and the distribution of Sleeping Sickness were found to be identical. "Where none of these flies existed there was no Sleeping Sickness." Doctors Ford and Dutton discovered a trypanosome in the blood of a European suffering from fever on the Gambia, and they suggested this was the first stage of the disease. It is now accepted as a fact that the *Trypanosoma Gambiense* and the trypanosome found in Sleeping Sickness are one and the same parasite.

The *Glossina*, or tsetse-fly, is confined to Africa, and inhabits the tropical and sub-tropical regions. The northern boundary of the fly-zone runs from Cape Verde across the middle of Lake Chad to the Nile. Its southern limit extends from the mouth of the Cunene River, at Cape Frio, to the southern boundary of Angola and to the north-eastern end of St. Lucia Lake, in Zululand. These boundaries correspond very closely to those within which trypanosomiasis is known to prevail.

The flies are brownish or greyish-brown in colour, and all of them have a prominent proboscis which is distinctive. The *Glossina palpalis* is the darkest of all the species. The Boers first came across the tsetse between 1835 and 1837, when they made their well-known trek. Later it was found near the Limpopo river by British settlers. Its name is probably derived from the peculiar buzzing sound it makes when flying, or when commencing to suck blood. Mr. Austen, who has made a special study of these insects, and whose book on the *Glossina* is a standard work on the subject, describes it as having a buff-yellow median stripe on the abdomen, and pale "femora," or thighs. The hinder-half of the body is of a paler colour, and has sharply-defined dark-brown bands. When in a resting position the tsetse can be distinguished from all other diptera (or two-winged flies) by its brownish wings lying folded flat, one over the other, down the back. The wings overlap like the blades of a pair of scissors do when closed. The proboscis, sheathed in palpi, projects horizontally in front of the head. The length of the insect, from the tip of the proboscis to the end of the closed wings is about half-an-inch. It is a peculiarity of the *Glossinæ* that they do not lay eggs, but "extrude a yellow coloured larva," nearly as large as the abdomen of the parent fly. At the posterior end of the larva are two projections; the body is divided into ten segments, and is full-grown when extruded. The insect crawls away at once for cover, and after a few hours changes colour and forms a hard and black pupa. Here, also, the tumid

lips of the last segment are well seen, and they are covered with granules. The notch between the projections is larger than in the larva. In about six weeks time the fly is fully developed.

The habits of *Glossina palpalis* differ to some extent from those of *Glossina morsitans*. Both are blood-suckers, and resemble each other very closely in appearance, but the former feeds largely on human blood, and the latter appears to depend for its existence upon animals—on big game in particular—and when these are exterminated the tsetse fly may die out. At any rate it is not found where they are absent.

Unlike the mosquito, the *Glossinæ* of both sexes suck blood. When it scents its prey the tsetse makes its peculiar buzzing noise and flies straight to the most accessible part, by preference, to the leg or foot, if exposed. The site of puncture is very painful at once, but it is stated no irritation follows later. A hard nodule may remain for a few days unaccompanied by any marked swelling or discolouration (Christy). In about half-a-minute to two minutes the fly is filled with blood, and after feeding flies away slowly and hides itself, digesting its meal while resting.

As already mentioned, the tsetse inhabits belts or patches of forest, and is seldom far from water of some kind. Bush, banana plantations, and the margins of rivers, lakes, and watercourses form its favourite haunt. At fords and bridges, and where human beings are constantly to be met with, the *Glossina palpalis* abounds; also within the interior of forests, though in far less numbers. It does not bite, as a rule, early in the morning; more often during the later period of the day, and even late in the evening. During wet and dull weather, fewer flies are encountered, and at certain times of the year these are either quiescent or absent. Further observations are needed on this point, and it is very probable that their habits vary with local conditions.

For the spread of Sleeping Sickness, it is necessary:

1. That individuals have trypanosomes in their blood.

2. That the particular species of tsetse-fly bite them.

3. That the fly within forty-eight hours, or at most within three days, inoculate a non-infected person.

So far as is known at present, *Glossina palpalis* is not able to, or does not, retain its infective quality beyond that period of time.

Evidence is accumulating that not only this fly, but others of the same species, may carry infection to man and also to animals. It has been ascertained by experiment that monkeys, guinea-pigs, rabbits, rats, and other animals can be inoculated with human trypanosomes taken from cases of Sleeping Sickness, the infective material being present in the blood. Experiments with such biting-flies as *Stomoxys* and *Tabanus* have not been successful in animals infected with Nagana, but these flies can spread the trypanosome of Surra in India.

Let us now turn our attention to this mysterious organism, the trypanosome. It was first found in the blood of a patient suffering from fever in the River Gambia Colony by Forde in 1901. Dutton, who was working with him (and who has since died in Africa when engaged in research-work), recognised the parasite, and named it the *Trypanosoma Gambiense*. It is formed of protoplasm, is single-celled, and has an irregular shape. It is pointed at each end, possesses a nucleus, a smaller dot or nucleolus, and a peculiar wavy line, known as the "undulating membrane," which commences in the nucleolus at one extremity and terminates at the other anterior end in a fine thread or "flagellum." This acts as a propelling organ, and by lashing movements the trypanosome swims about in the blood-stream—a worm-like organism wriggling actively among the blood-dics. Differences of sex have not been discovered in these bodies. They reproduce themselves by splitting up along their length—by "longitudinal division" as it is termed. Recent observers suggest the theory that the two nuclei are connected by a band which can be seen to grow out from the small, and to extend through the body of the organism, towards the larger nucleus and even beyond it. This structure is thicker than and quite distinct from the "undulating membrane," and when it is complete small trypanosomes are formed, and the life-cycle of the parasite recommences. At present the evidence is still in favour of the view that all the stages of development of the trypanosome of Sleeping Sickness are completed within the body of its human host and not in the alimentary canal of *Glossina*—differing thus from what takes place in the mosquito, which is the carrier of the germ of Malaria. We know that the parasite is found in flies caught near huts containing

persons suffering from the disease, and it is believed by some that in the alimentary canal of the fly the organism mutiplies and undergoes some change. Yet preparations made from the blood taken from the stomach of the tsetse and examined microscopically have not shown that alterations or stages occur.

The question may suggest itself, "Whence comes the original trypanosome?" That we cannot answer, as it amounts to explaining an *initium vitæ* which Science cannot at present elucidate. The parasite passes from the fly directly into the blood-stream of its victim. Later it invades the lymphatic glands, and last of all passes into the spinal fluid.

Turning next to the symptoms of the disease —which I shall only touch lightly on—it has not been possible to tell how long a person may remain infected without showing any signs of the malady. This hidden or "latent" stage may extend over a year or more; or the signs of illness may be so indefinite, or may come on so gradually that suspicion is not easily aroused. The first symptom that attracts notice is an enlargement of the glands in the neck wihout obvious cause. Other glands also became infected. From these glands the parasite may be obtained, and then all doubt as to the nature of the affection is removed. Later on nervous symptoms supervene—great lassitude, dullness, lethargy, or a stolid expression or puffy state of the face; and with these great emaciation occurs. It is important to note that in cases which ended fatally, sleep symptoms were occasionally not in evidence, and in others they were slight and unimportant. The nomenclature commonly adopted may, therefore, be misleading; this heavy sleep is symptomatic in a comparatively small number of cases, and in every instance, when present, it indicates the terminal stage of the disease.

Treatment by drugs has, I regret to say, not been satisfactory. Recently Atoxyl has been administered, and a few patients have apparently benefited under its use; it is still under trial. Strychnine and arsenic have also been given, and are not curative.

Electricity has been been brought into use, and Ross, of the Liverpool Tropical School of Medicine, states it has no effect on trypanosomes. In Paris the Benzidine colour treatment (on animals) has not been satisfactory. More recent investigations on monkeys have given better results, but it is quite uncertain if these drugs will cure the disease in man.

Turning, lastly, to preventive medicine, what can be done to check a fatal disease, which is spreading rapidly in Africa, and which may, by extending along trade routes, invade South Africa, Egypt, the Soudan, and India? Is it possible to exterminate the tsetse fly? Administrative measures must be taken to control the movements of infected people. It is difficult to discover the disease at an early stage, and, consequently, a dangerous class exists which forms a focus of infection wherever the *Glossina* is found. It follows, therefore, that a special staff of experts is needed to detect early cases. The geographical distribution of the tsetse-fly in Africa is not accurately known, and there may be other species which convey infection.

Posts of inspection should be instituted along trade routes, so that all suspicious persons can be examined by medical experts. Infected individuals should be removed from uninfected districts, and every employer of labour ought to be compelled to have his men examined and treated.

That the disease may invade Egypt and India is only too possible. In South America a fly disease infecting horses is known to exist, and in India Evans first discovered a trypanosome, in 1880, which causes a disease known as "Surra" in horses and cattle, and is due to the bite of a blood-sucking fly. A similar parasite has been found in French Indo-China.

Foreign Governments have taken up the matter. The King of the Belgians has interested himself, and has instituted a prize of £8,000 for anyone who discovers a cure for the disease. He has, in conjunction with the Congo Free State, provided an institute for research, with a suitable staff located in the endemic area. The German Government has voted £6,000 for an expedition under the celebrated Professor Koch; the French Geographical Society has organised an expedition, and has set aside £8,000 for estimated expenses during a period of 18 months.

The British Government has not taken very active steps in the matter. Questions have been asked in Parliament, and it was stated in November last that two medical officers were to be sent to British Central Africa to study local conditions and to suggest preventive measures, and they were expected to arrive there by January of this year. It has been suggested that game-preserves in Africa might spread infection; but the Commissioner of the British Central African Protectorate and of North-East

Rhodesia reported that no such evidence was forthcoming. The Secretary of State for the Colonies stated, "if it could be shown that the removal or the contraction of the reserve would increase the health and security of the neighbourhood, instructions would be given accordingly."

A Commission to investigate the occurence of Sleeping Sickness in the Soudan has been appointed. Liverpool has taken a leading part in investigating the disease, and the Chamber of Commerce there passed a resolution last year to call the attention of the Secretary of State for the Colonies to the importance of active measures being taken. On the 4th of this month two members of a Commission from the Medical School left for Central Africa to prosecute further researches.

The Germans are closely watching the Uganda border to prevent the extension of the disease into their possesions. Epidemics are not abating but on the contrary are invading new districts. It is of the greatest importance for the British Government to take the lead as it has the largest interests at stake; and it is a dangerous policy to act on the motto *Festina lente !*

May I ask if this Society, with its well-known scientific status and its influential Council, can take action in the matter?

DISCUSSION.

The CHAIRMAN, in opening the discussion, said that being only a layman it was not competent for him to offer any criticisms on a paper which had been carefully thought out by an expert; but he desired to say he was cordially in accord with the concluding paragraph of the paper, in which Dr. Macleod stated that, in view of the action being taken by other nations, it was of the greatest importance that the British Government should take the lead, as it had the largest interests at stake. He had served in the tropics for 30 years, in Labuan, Borneo, and the Federated States of the Malay Peninsula, and he had frequently seen scattered over those countries cemeteries in which were buried a comparatively large number of white men, such as soldiers, sailors, civilians, planters, and merchants. The graves of many Chinese and Tamils were also to be seen, they being the races from which the labour forces of those colonies were recruited; and the larger proportion of those deaths was undoubtedly due to malarial fever. Apart from the sad loss of life, it was easy to imagine what a wastage there had been of labour and money, and what a delay had occurred in the development of those countries owing to the mortality which had taken place, much of which could have been minimised if the British Government had earlier taken up the study of tropical diseases, and endeavoured to counteract their ravages. It was not until Mr. Joseph Chamberlain took charge of the Colonial Office that anything was really done in that direction, and since then the London and Liverpool Schools of Tropical Medicine had been originated, at which doctors went through a course of training which fitted them to cope with tropical diseases. As a concrete instance of the value of his training, he might mention that, not very long ago, he opened a new harbour, known as Port Swettenham, on the west coast of the Malay Peninsula. Soon after it was opened, malarial fever, of a most virulent nature, attacked the inhabitants of the district, the coolies and the crews of the ships, and he was asked to close the Port, at any rate for a time. Instead of doing so, he called in the Government doctors, who had been trained at the London School of Tropical Medicine, and the Government engineers; a scheme of drainage and of other remedial measures was carried out, and in a few months the place was perfectly healthy; indeed it was now almost regarded as one of the healthiest seaside resorts on the coast, and vessels of the P. and O. and other companies were making use of it.

Sir JOHN CAMERON LAMB said that as Dr. Winterbottom was a fellow townsman of his he had been exceedingly interested in the author's statement that Dr. Winterbottom was one of the first men who described sleeping sickness. Only a few weeks ago he received from another old friend, Dr. James Gray Glover, a confirmation of that fact, and the further statement that Dr. Winterbottom's paper, though written more than 100 years ago, was still regarded as a treatise of considerable value. He had personally felt very depressed while listening to the paper, because everything seemed to be so hopeless; but it might cheer the meeting, as it cheered himself, to know that Dr. Winterbottom, although he gave so much attention to such a hopeless subject, was one of the most cheerful persons who ever lived. It was encouraging to all concerned that a man who was so deeply concerned in the study of the subject should keep up his spirits, and he hoped they would all do so in spite of the very depressing but nevertheless most interesting statements of Dr. Macleod.

On the motion of the CHAIRMAN, a very hearty vote of thanks was accorded to Dr. Macleod for his interesting paper.

Dr. MACLEOD, in reply, cordially thanked the audience for the kind way in which his paper had been received. He had endeavoured to keep outside professional grounds and make it as popular and simple as possible. If he had failed to do so he regretted it, if he had succeeded in what he had done his pleasure was great.

THE COMMERCE OF THE BRITISH EMPIRE IN 1905.*

This valuable return, now appearing for the third year in succession, gives a general review of such matters as area, population, export and import trade and its distribution, shipping statistics, and production of certain staple commodities. In these notes a few of the more striking figures of a year of general expansion and unequalled activity will be referred to.

Total Trade of the British Empire.—The total foreign and inter-imperial trade of the Empire in 1905 reached the total value of £1,366,708,000, an increase of £62,000,000 over 1904, and of £354,000,000 since 1897. Of the sum total, 74·1 per cent., or £1,012,141,000, represents the external foreign trade of the Empire with foreign countries, of which the exports amount to £448,688,000, and the imports to £563,453,000, and 25·9 per cent., or £354,567,000, represents the inter-imperial trade, comprising £161,900,000 of imports into the United Kingdom from British Colonies and possessions, and £135,524 000 of exports from the United Kingdom to the rest of the Empire, together with an intercolonial trade reckoned at £57,143,000, being the value of goods imported into the colonies from other colonies.

As regards the total volume of trade between the Empire and specific foreign countries, first place is taken by the United States of America, to which the exports were valued at £83,631,000, and from which the imports were valued at £173,687,000. The exports to Germany were £61,613,000, and the imports from Germany were £48,608,000. Other leading countries to which exports were sent were—France, £51,433,000; Belgium, £23,237,000; Russia, £20,015,000; Holland, £16,731,000; China, £20,683,000; Japan, £18,467,000; and the Argentine Republic, £16,887,000. The imports from these countries were—France, £57,917,000; Belgium, £33,307,000; Russia, £35,268,000; Holland, £37,352,000; China, £4,425,000; Japan, £4,336,000, and the Argentine Republic, £26,442,000.

Staple Articles Imported from Foreign Countries.—Dealing only with specific raw materials and omitting food-stuffs, the imports of raw cotton into the Empire amounted to £52,299,000, of which £50,989,093 was imported by the United Kingdom at £1,148,268 by Canada. Raw wool was valued at £5,769,000, of which £5,285,653 was for the United Kingdom. As regards iron ore, the United Kingdom imported £5,453,474, a small quantity imported by Canada not being separately distinguished. The timber imports amounted to £22,065,000, of which the United Kingdom took £18,000,845.

Exports of Staple Articles to Foreign Conntries.—Confining our notes again to specific raw materials, the most important exports from the Empire to foreign countries amount as follows:—Coal, £25,380,000 (mainly from the United Kingdom); raw cotton, £19,376,000 (mainly from British India, £13,139,079), the sum of £6,132,927 representing re-exports from the United Kingdom; raw wool, £26,867,000, (£14,912,341 from the United Kingdom, and £11,045,631 from the Australian Commonwealth); and timber £5,428,000 (of which £4,110,023 was from Canada).

Raw Materials and Manufactured Articles Imported into the United Kingdom from British Colonies and Possessions.—Copper ore, £295,534; copper regulus and precipitate, £782,657; unwrought copper, £850,852; raw cotton, £1,202,563; raw jute, £5,669,239, raw wool, £20,600,774; tin, £5,425,040.

Manufactured Articles Exported from the United Kingdom to British Colonies and Possessions.—In view of the many headings under which these returns are made only a few can be recited, these figures being compiled from the annual trade statements. For instance, out of cotton manufactures having a total value of £37,697,702, British India received £24,811,875, the Australian Commonwealth £3,315,325, Canada £1,605,678, the Straits Settlements £1,572,441, and Hong Kong £1,412,490. Woollen and worsted manufactures totalled £8,502,602, the chief purchasers being British India, £936,252; the Australian Commonwealth, £2,181,023, and Canada £2,713,108. Machinery and mill-work totalled £7,006,888, India purchasing £3,871,471; the Australian Commonwealth £813,432, Cape Colony £582,748, Natal £570,721, and New Zealand £327,940.

Shipping Statistics.—The bulk of the tonnage of vessels built within the Empire is launched within the United Kingdom, where, exclusive of war vessels, 1,037,838 tons was launched in 1905. Other totals are—British India, 7,422; New South Wales, 1,273; New Zealand, 1,395; Canada, 21,865; Newfoundland, 3,121; Straits Settlements, 9,189; Hong Kong, 3,695; and West India Islands, 388. The total tonnage of sailing and steam vessels on the register for the Empire as a whole was 12,332,404, of which 10,735,582 tons was registered as belonging to the United Kingdom, 85,777 as belonging to British India, 352,455 to the Australian Commonwealth, 668,314 to Canada, 117,583 to New Zealand, 129,617 to Newfoundland, and 48,769 to the West India Islands.

Other interesting tables show the volume of shipping entered and cleared between the United Kingdom and each colony, and summarised tables show the small extent to which foreign-owned vessels participate in this trade.

Total Values and Quantities of Staple Articles Produced within the Empire.—In regard to all industries connected with mining save that of coal, the total value produced in 1905 exceeds that recorded for any preceding year. Even in regard to coal, the volume produced exceeds all other records in volume by reaching 265,356,000 tons, of a value of

* Compiled from the Statistical Abstract for British Empire 1891-1905 (Cd. 3328); published by Wyman and Sons, Ltd., Fetter-lane, E.C. Price 1s.

£91,700,000; which may be contrasted with 1900, when the volume was 244,378,000 tons, and the value, £128,800,000. The iron ore produced amounted to 15,600,000 tons, and the pig iron produced (partially, of course, from imported ores) was 10,079,000 tons. The gold production reached 11,106,000 ounces of varying fineness, valued at £46,600,000. The value of the copper produced was £4,184,000, and of tin, £8,700,000.

Passing to statistics of agricultural production, variations in the total yearly production are naturally encountered. So far as can be enumerated the yield of wheat in 1905 was 535,600,000 bushels, a figure exceeded in 1903 by nearly 20,000,000 bushels, but 95,000,000 bushels in excess of 1904. The barley production amounted to 109,200,000 bushels, a figure slightly exceeded in 1902. The yield of oats in 1905 was 341,100,000 bushels, 1902 being the year of greatest production, when the total was 354,400,000 bushels. The total amount of tea amounted to 398,184,000 lbs., a figure more than double that returned in 1891. The coffee production is less satisfactory, very violent fluctuations occurring. The yield in 1905 was 41,494,000 lbs., with which may be contrasted the minimum yield of 28,901,000 lbs. for 1901, or 59,195,000 lbs. for 1891, which is the first year covered in this summary. Complete figures as to the production of raw sugar were only available in 1898; the yield reported for 1905 of 47,200,000 cwts. is the lowest in the period under review. The yield of rubber in 1905 was 9,253,000 lbs., a figure which may be contrasted with a yield of 3,900,000 lbs. in 1902, or 12,787,000 lbs. in 1896.

The total production of cotton amounted to 1,306,188,000 lbs., of which 1,299,600,000 lbs. was Indian grown. Other quantities included: British Central Africa, 2,377,760 lbs.; Lagos, 1,281,072 lbs.; Barbados, 344,232 lbs.; and Cyprus, 782,712 lbs.

Other tables deal with wool production, and also the number of live stock, coal, iron, and tea, beer, wine and grain consumed (in bulk and *per capita*), to which reference can be readily made by those interested in specific items not dealt with in this summary.

THE INDIAN MOTOR TRADE.

India is rapidly taking a leading place in the world's motor markets, and this country is worth the careful attention and thorough investigation of manufacturers who are seeking to enlarge their markets. The value of the trade is seen from the official statement that the motor cars, motor cycles, and cycles, imported during the last fiscal year amounted approximately to £42,000, of which one half was through the port of Bombay, the supply mart of Western India. Accessories, which are classed under different headings, add to this total, while fuel and lubricating oils have had largely increased sales since the use of motor cars has become popularized. One cause of the popularity of the motor in India is the number and the extent of good roads, some of them hundreds of miles in length. A perfect highway runs from Bombay to Delhi, 900 miles, over which the trials were made in 1904. From Peshawar, further north at the frontier of Afghanistan, a fine road extends all the way to Calcutta, a distance of 1,500 miles. These and similar roads are known as the grand trunks, and were built and maintained as military highways before the advent of the railways. They are kept in a perfect state of repair. Other highways equally good are spread throughout the country, and in some of the States ruled by the native princes, great attention is given to the roads. One enterprising prince, the Maharajah of Gwalior, has caused a motorists' road guide of his State to be published with maps, lists of rest-houses and other information. The high class and high-priced cars, which in any country must be considered as luxuries, have found their best customers among the native rulers, whose example has been followed by the rich Parsee merchants and financiers of Bombay, and in a modest degree by some of the officials of the Indian Government. According to a recent report by a Special Agent of the United States Government, the use of motors has gradually spread until they have ceased to be looked upon as luxuries, and are now regarded as necessaries by a growing number of people who are able to invest from £200 up to £1,000 in a motor vehicle. At first it was found necessary to employ European chauffeurs, and this is still done by the owners of the finest machines, but it is now possible to obtain competent native chauffeurs at very moderate wages. The touring car will probably continue, for some time to come, to offer a good field for exploitation, since it is especially favoured by Government officials for use by themselves and their subordinates in reaching districts not accessible by the railways, and it should be understood that there are still many parts of India without means of railway communication. This is especially true of several of the Native States, whose rulers have been very enterprising in providing means of transit. The number of touring cars to be seen in the warehouses and garages of Bombay is also noticeable. Motor 'buses, however, are yet to be introduced in the chief cities. The motor cyele has a fair sale, and the bicycle has not been relegated to the background, as in other countries. The large number of British troops maintained in India is one explanation of the continued use of the motor cycle and the bicycle, since they are especially adapted to military needs. The value of the imports of bicycles is about £100,000 annually. A disposition exists in official circles to encourage the use of motor transport wagons for goods, as the solution of one of the many problems with which the Government has to deal, in the economic affairs of the country. In many of the interior districts much loss results every year through the inability of the country people to get their produce to market. The official suggestion is, that motor wagons might be manufactured, which could transport the produce to the railway station and then to be transferred to the railway trucks and be carried as are ordinary goods from station to station. Kerosine is proposed as the

most suitable fuel for machines of this kind, since the handling of highly volatile spirits such as gasoline is relatively costly in a country of high temperature, which India is. The significance of this suggestion regarding a special kind of motor for the railway trucks, is its recognition that touring and passenger travel is not the only use to which the motors can be put. Motor boats are also seeking an Indian market. The Government has ordered from England a police-boat which is to be fitted with a 6-horse power paraffin motor, and is to have a speed of six miles an hour. The dimensions are to be eighteen feet length and five feet beam. Since this boat may prove the type of others that will meet the requirements of Indian waters, further details of the construction are given. The shape is rectangular, with curved-in ends and sloped-up floor at bow and stern. The paddle wheel propeller is fitted inboard and not beyond the stern, as is customary. The engine is provided with a reduction pulley, whence power is transmitted to the paddle wheel by a broad flat belt. No clutch or reverse gear is provided. Instead, a jockey pulley serves to regulate the tension on the belt, allowing it to slip when required, a lignum-vitæ block-brake being at the same time applied to the belt. The boat is provided with two rudders, is built throughout of teak, and is copper sheathed. A few orders are said to have been given recently for motor-boats from Europe, while a local industry has sprung up in Bombay for the manufacture of hulls, the engines and machinery to be imported. It is claimed that the high-sea freight on motor-boats will prevent the importation of the hulls. The effort is also made to increase the use of paraffin or alcohol for fuel in place of gasoline, since the safety will be greater by the use of a heavier and non-inflammable material.

The important trade, however, for the motor industry in India will always be on land, rather than on water, and some additional particulars, therefore, may be of interest regarding the type of machines in use, and which promise to command the most profitable market. The Indian motorist does not care for great horse-power in the engines. From sixteen to thirty horse-power is the range, with a decided preference for the lower figure. Much attention, however, is given to the coach, which is expected to be both substantial and luxurious. The coach finish of the American cars, for example, is criticised for its roughness, and this objection applies also to the upholstering. Red leather is not disliked, and it may be said that the buyers in India, especially the natives, want plenty of light colours. They are also particular in wanting attractive engine fittings. The American motor-car is also too high to suit the motorists in India. They are accustomed to the English and French cars, hung low from the axles, and object to the inconvenience of climbing in and out of the automobile. Cars made for "bumpy" roads are not needed on the perfect highways of India. Other considerations are of a technical nature, such as relate to the very hot Indian climate, and also to protection from the penetrating moisture of the monsoon or rainy season, for motoring is not entirely restricted to the dry season. Generally, it may be said, that increased horse-power is of the least importance, and that the growing market is for machines built on the French lines. The trade up to this time has been largely controlled from England. The importations into Bombay, during the last fiscal year, from Great Britain, were valued at a little more than £100,000, and from France, about £18,000; but many of the machines credited to England in the Customs returns, are manufactured in France. The colonial rights are held in Great Britain, and under this arrangement the cars are often invoiced and shipped direct from France. Complaint is made that the British manufacturers are not up-to-date, and the concerns holding colonial rights from some of the French manufacturers are likely to do an increasing business. Italy has lately come into the Indian market with its perfected machines, and though the importation last year amounted in value to only £6,500, the future promises to show marked gains. The customers for the Italian high class cars have been found among the wealthy natives. The imports into Bombay from the United States were only valued at £3,000, though several years ago this total was exceeded, and great efforts are now being made by American manufacturers to gain a greater share of the Indian market, and with this object in view an American company has now manufactured a somewhat heavy machine, of 30-horse power, which in some particulars seems to satisfy the requirements of Indian motorists. There are more than six hundred licensed motors in Bombay, and it is observed that the latest licenses granted are for the more substantial cars.

ALCOHOLIC CONSUMPTION AND REVENUE.

For the sixth year the Board of Trade has just issued its memorandum and statistical tables showing the production and consumption of wine, beer, and spirits in the British Empire, and in the principal foreign countries, and the revenue derived therefrom in recent years. In addition to the beverages so classed there are certain others of a more or less alcoholic character not dealt with in the tables. No figures, for example, are available with regard to the production or consumption of cider in the United Kingdom, and so with revenue. Only the revenue raised for national purposes is considered, revenue raised for local purposes, whether in the form of octrois, and so on, being, as far as possible, excluded.

The quantity of wine produced in the British Empire is only very small. Practically none is produced in the United Kingdom or anywhere in the Empire other than the Cape of Good Hope and the Commonwealth, and in the Commonwealth the production is practically stationary. Whilst in 1901 Australia produced more than twice as much wine as the Cape of

Good Hope, in 1904 the Cape production exceeded that of the Commonwealth. It will surprise many to find that, although France holds the first place as a wine producer, even in such years as 1900 and 1904, she imported considerably more than she exported, her imports being derived principally from Algeria and Spain, and consisting for the most part of strong common wines, used chiefly for fortifying wines of French origin. About one-half of the rapidly-increasing production of Algeria is, in fact, taken by France. The consumption of wine in the British Empire is, as might be expected, relatively small, and it has beeu falling considerably since 1899. In 1905 it amounted to only a little more than a quarter of a gallon (·27 gallons per head). On the other hand, the consumption seems to have increased considerably in several Continental countries. In the quinquennial period 1891-5, the consumption in France was 23·0 gallons. In 1900-5 in had risen to 30·8 gallons. Taking the same periods, consumption had increased in Italy from 20·6 to 25·1, and in Germany from 1·10 to 1·45.

Turning to beer, it will be seen that in the United Kingdom the consumption has steadily declined since 1899, when it was 32·6 gallons per head of population, to 27·7 in 1905. But even the last figures are higher than those for any other country included in the tables except Belgium, where the consumption for some years showed a strong tendency to increase, having risen from 39·2 gallons in 1891 to 48·8 in 1905. In Germany, the consumption per head has ranged from 23·2 gallons in 1891 to 27·5 in 1899, and 26·3 in 1905. These figures apply to the whole of Germany. In particular parts of the Empire the consumption is much larger, as for example in Bavaria, Wurtemberg, and Baden. In these countries the figures for 1905 were 34·5 gallons in Baden, 38·1 gallons in Wurtemberg, and 51·7 gallons in Bavaria, the consumption in the latter country per head of population being greater than in Belgium, or in any other country of the world. It is noticeable that, taking the years 1901 to 1905, there is decline in consumption not only in the United Kingdom but in Australia and New Zealand, the only British colony showing increase being Canada. So with foreign countries; in all the Continental countries, with the exception of Belgium, where during these years the consumption has been practically stationary at 48 gallons per head, consumption has been declining, but in the United States there has been an increase from 14·6 to 16·8.

During the fifteen years dealt with in the return, the consumption of spirits per head of population in the United Kingdom has followed nearly the same course as the consumption of beer, having been low (0·97 proof galls.) in 1894, from which point it increased yearly to 1 09 galls. in 1899, and to 1·11 galls. in 1900, and has since decreased each year to a total of 0·9 galls. in 1905. The consumption of spirits per head of population in this country is lower than in any of the Northern and Central countries of Europe except Norway and (for one or two years) Russia. In the United States the consumption per head of population was greater than in the United Kingdom in 1891-3, but less than in 1894-1900. In 1901-5 it was again greater, having increased, whereas the consumption per head in this country diminished. In nearly all the Australian States there has been slight decrease in consumption, but in Canada it has risen from 0·76 to 0·94. In most Continental States there is a slight decrease, and in Belgium a considerable one, from 1·89 to 1·10, but this is attributed to the increase in the excise duty, which rose in 1903 from 100 francs to 150 francs per hectolitre.

An interesting series of tables is given in the returu showing the large part played by the revenue derived from alcoholic beverages in Governmental finance. Nowhere do taxes on these beverages contribute so large a part of the total national revenue as in the United Kingdom and the United States, the proportion so attributed in both countries for the years 1901-5 amounting to no less than 28 per cent. of their respective revenues. Next comes Holland and the Dominion of Canada, which derive 18 per cent. of their revenue from these beverages. Russia, Sweden, and Belgium get 17 per cent., and France 15 per cent. The proportion falls exceptionally low in Italy, Spain, and Servia, in which countries only 2 per cent. or less of the revenue is derived from the taxation of alcoholic beverages. If the revenue from Customs and internal taxation is taken, it is interesting to know that whilst the amount raised by internal taxation of wine, beer, and spirits in this country is surpassed by both Russia and the United States, the Customs revenue derived therefrom far surpasses that of any other country, and is more than twice as great as that of the United States, which stands second in the list.

JAPANESE EXHIBITIONS.

The Japanese patent-office exhibition building at Dosan Machi, Kojimachi, Tokyo, was opened on February 1st, 1907. The building is new and covers about 6,120 square feet. The exhibits, numbering over 2,200, are for the most part articles invented or designed by the Japanese and are protected by either Japanese patent or registration. Among them are clothing, boxes and receptacles, dyed and woven goods, buttons, rings, fans, stationery, toys, agricultural tools and implements, furniture and chemical apparatus, and among the patented articles are found fire extinguishers, engines, pumps, agricultural tools and looms. The exhibition is a permanent one and will be open daily. In connection with the international exhibition to be held in Japan in the year 1912, the following revenue is, according to the American Consul-General at Yokohama, reported and estimated—from the municipality of Tokyo, £300,000; from the national treasury, £500,000, and revenue from the exhibition, £200,000. The area of the exhibition ground is estimated at about 10,800,000 square feet. The principal buildings to be erected by the Government are two scientific buildings, two in-

dustrial buildings, two machinery and electric buildings, transportation buildings, marine product building, zoological, fine arts, agricultural, mining, forestry, foodstuffs, aquarium, and horticultural buildings. In addition to the foregoing, three concert halls for the use of the public, and a post and telegraph office will be built. Both foreign and domestic exhibits are to be classified, and will be placed in the sections devoted to them. The exhibitors will be allowed to erect buildings for their exhibits within the exhibition ground at their own expense. The site of the exhibition has not yet been selected, but the Finance Department and the Tokyo municipal authorities are reported to have agreed to hold the exhibition within, or in the vicinity of Tokyo, and the Tokyo Municipal Council recently voted a contribution of £300,000. The exhibition will be formally opened on April 1st, 1912, and is to continue for seven months. At the instigation of the Chambers of Commerce of several of the larger cities of Japan, aided by the civil authorities of Dalny, a commercial exhibition was opened in that city on February 1st last. One building composed of eight rooms is being used for the exhibition. The Japanese Commercial Museum at Mukden has proved to be such a success that it is contemplated keeping it open much longer than was originally intended. The Government and people of Japan are thoroughly imbued with the importance of exhibitions for the display of their products. There is in the City of Tokyo, a permanent industrial museum under the Department of Commerce, and almost every city of prominence has some form of a commercial museum of a permanent nature. Recently a train was fitted up for the purposes of a travelling exhibition. This was especially encouraged by the press, and was supported by a number of the leading commercial interests. It travelled over the various lines, and was well visited. It is a part of the policy of the Government to assist their merchants by exhibitions of their products, especially throughout China, and wherever a Japanese Consulate is established, there are a number of young commercial students attached to the Consulate, engaged in studying commercial affairs, as well as in developing and assisting in marketing the products of Japan. By this method a great number and variety of Japanese manufactured articles are being distributed and sold in various parts of the Chinese Empire. The Government considers it a part of its functions and duties to encourage Japanese commerce in every conceivable form, and the exhibition spirit seems to be one of the leading methods of rendering aid to Japanese trade. In nearly all these commercial museums and exhibitions the Government's position is that of merely aiding and assisting the manufacturer. A few months ago the Government sent to Manchuria, free of expense, a large body of business men and commecial students. These men were given every opportunity of making a special study of the markets for Japanese products, as well as of examining the possibilities of developing and placing on the markets in Japan the products of Manchuria, and it is largely by such methods as these, and their various museums and exhibitions, that the Japanese are extending their trade throughout the East.

THE INTRODUCTION OF ELECTRICITY INTO DAMASCUS.

Two years ago most people even in Turkey scoffed at the idea of electric lighting and traction being introduced and actually established in Western Asia. The Damascus-Mecca railway scheme was greeted with derision or at least with profound scepticism. However, even then to the careful observer there were signs—and these are gradually multiplying and becoming more pronounced—that the dawn of a great awakening is slowly coming in the near East. Electricity has been admitted into the Turkish Empire. The American Consul-General at Beirut says that he recently visited Damascus, and saw overhead trolley cables in the streets, and a few miles up the Barada river the station erected for the generation of electric motor power. Damascus, the oldest surviving city in the world and the most typically Oriental one in the Turkish dominions, leads in Turkey in adopting electricity for purposes of light and locomotion. The harnessing of the Barada for such ends emphasises the change which is fast overtaking Ottoman industrial and social life. On February 7, 1907, Damascus celebrated an inauguration of more than passing interest. In the presence of the Governor-General of the Province and the General in command of the fifth army corps, besides the civil and military officials, notables of the city and foreign consuls, on that day the new electric street cars and street lighting service in Damascus were handed over by representatives of the Ottoman Government, who had come from Constantinople for that purpose, to the Societé Ottomane Impériale des Tramways et d'Eclairage Electrique de Damas. It was a red-letter day in the annals of Ottoman Asia. At first the street service will cover only the distance from Salhyeh to the Meidan, some five miles through the city from suberb to suberb. Cars were to commence running on March 14th on which day the Ottoman fiscal year begins. Electric lights have been installed, and Damascus is now being lighted by 1,000 electric street lamps for which the municipality pays an annual rental of £2,750. Besides these the company have put in more powerful lights in the Grand Mosque, in the public squares, and in the Serail. Private electric lights are soon to be introduced in shops and residences. The installing company is Belgian. Some of the electrical supplies and apparatus have come from England, Germany, and France, but all cars, motors, dynamos, &c., have been bought in Belgium. Concessions for electric lighting and street railway undertakings have been granted to corporations in Damascus, Beirut, Aleppo, Smyrna, and Salonica. So far nothing has been heard of the authorisation of telephone companies.

HOME INDUSTRIES.

Masters and Men in the Engineering Trades.—A most important agreement has been arrived at between the Engineering Employers Federation, and the engineering trade unions. For nearly ten years the Federation and the Unions have been working under an agreement which was the outcome of the disastrous strike of 1897. On the whole it has worked well. If friction has not been avoided, it has prevented conflict. But the men have been anxious to secure certain modifications of the agreement, desiring the position of the unions to be more fully recognised, and the amended agreement secures this. The first condition of the new settlement is, that "The federated employers shall not interfere with the proper functions of the trade unions, and the trade unions shall not interfere with the employers in the management of their business." Here is the basis of the principle of mutuality. Next, under the agreement, every employer may belong to the Federation, and every workman to a trade union, or not, as they may desire. It follows that every employer may employ any man, and every workman may take employment with any employer whether he belongs to a federation, or a trade union, or not. No workman will be required, as a condition of employment, to declare whether or not he is a trade unionist, and the unions will recommend their members not to object to work with non-union men. And whilst the non-union man is thus recognised by the union, the employers will not object to employ any man simply because he is a member of a trade union. The employers want freedom of labour, but they know the advantage of having highly organised bodies of workmen to deal with. After the 1897 strike, and when the disputants were negotiating the agreement of 1898, the trade unions objected to leave any power with employers to make special wage agreements; but under the amended agreement they admit the right of the employers to employ workmen at wages "mutually satisfactory to the employer and workman concerned," but the rates must be adjusted to the rates prevailing in the district, for skilled men. And it is left to the trade unions, in their collective capacity, to arrange the rates of wages at which their own members may accept work. As to the numerical relation of apprentices to journeymen to be admitted into the trade, the unions do not lay down any rule, but they reserve the right to discuss the question of apprentices generally. Freedom is conceded to the employers to employ those whom they may consider suitable to work the machine tools, and to determine those conditions under which these shall be worked, but "the Federation recommend their members that when they are carrying out changes in their workshops, which will result in the displacement of labour—say by the adoption of some new machine tool—consideration should be given to the case of workmen who may be displaced, with a view, if possible, of retaining their services on the work effected, or finding other employment for them." It is agreed that systematic overtime as a method of production is to be deprecated. When it is necessary, no union workman shall be required to work more than 32 hours overtime in any four weeks, excepting upon specified emergency when it is not to be restricted. Piecework prices are to be fixed by mutual agreement, and it is agreed that piecework prices shall be fixed so that each workman's day rate be guaranteed, irrespective of his piecework earnings. It is not compulsory on an employer to give piecework. For the purpose of avoiding disputes there is to be discussion on any point of difference between masters and men, or between an official of the trade union and the Secretary of the Federation, and either party has the right to bring the matter before a local conference of representatives of employers and the unions. If this fails to effect a settlement, then either party may refer the matter to the executive board of the Employers Federation, and to the central authorities of the trade unions, who will meet in central conference at the earliest possible moment that can be mutually arranged. Meantime, "there shall be no stoppage of work, either of a partial or a general character, but work shall proceed under current conditions until the procedure provided for (as above) has been carried through." It seems to be a most admirable agreement, well calculated to avoid conflict in the engineering trades, and highly creditable to both masters and men.

The Scrap Iron Trade.—Great developments are taking place in the trade in scrap iron, copper, and other material. Every year more scrap iron, &c., comes upon the market. The rapidly increasing number of ships of old types which have ceased to be profit-making ventures, and are supplanted by up-to-date economic tonnage, and the evolution of the war ships, which necessitates the breaking up of ships of war that have ceased to be effective fighting machines, with the same principle at work in other departments of industrial life, is creating sharp competion with the crude iron produced by smelters, and it may be expected that the trade in scrap iron, which is a profitable one, will rapidly grow.

The Hosiery Trade.—The Leicester correspondent of *The Times* directs attention to the hosiery trade and the extent and character of foreign competition. Home yarn spinners are making headway in their struggle with foreign competition but there is still much leeway to make up. The home hosiery trade is at present in a prosperous condition, and important developments are in progress to meet foreign competition, and extend the colonial and shipping branches of the trade. But whilst business with Canada is increasing, and there is a steady expansion of the demand for English-made hosiery fabrics for Australian, Indian, Japanese, and Chinese markets, the home trade leaves much to be desired. Experts

estimate that at least five-eighths of the business done in hosiery in this country is in the production of foreign countries. There is reason to believe that more than half of the hose, shirts, pants, combinations, jerseys, woven under clothing, Tam o'Shanters, and endless varieties of knitted goods and specialties which are sold in Great Britain to-day are either wholly or partly of foreign production. Although in certain very important branches of the trade the goods are manufactured in this country, they are made up of yarns spun abroad, in France, Belgium, and Germany. In other sections of the trade, while the making-up is done here, the goods are composed of knitted cloths or fabrics manufactured abroad, and the remainder of the foreign imports consists of goods copied from English designs in a complete state ready for the retail trade. It is further alleged that a very large proportion of these fabrics when sold retail bear no notification of their foreign origin. English manufacturers of hosiery of all kinds, says the correspondent already quoted, are introducing new machinery to cope with the demand for low and medium priced fabrics in which the German and American manufacturers have taken the lead. In medium to low grade yarns Belgian and German competition is very formidable, and French spinners have a strong hold on a certain section of the trade. Great quantities of these foreign spun yarns are used in the manufacture of English hosiery. The Belgian and German pleating and cordon yarns made of cotton and wool are very popular, because they are cheaper than English yarns of a similar character. There is a large consumption of Verviers mule spun yarns. The Belgians turn out a soft yarn which is very regular and full as well as being nice to handle and to wear. It is very carefully produced, and is said to be better spun than the English yarns of a corresponding grade. These yarns are of cotton and wool combined, but they produce a softer and smoother fabric than if they were made of the lower qualities of strong wool only, which would be necessary to meet the price.

American Copper Imports.—On the face of it it is anomalous that the United States which produce half the copper production of the world, and export more copper than any other country, should also be among the largest importers of copper. The value of the copper imported into the United States in 1906 was 37,000,000 dols., including 6,750,000 dollars' worth of copper ore. The explanation is that the United States has superior smelting and refining facilities, and that copper from its neighbours north and south—Canada and Mexico—comes to its smelting establishments and refineries. Much of the pig copper imported is brought in for the purpose of extracting the precious metals which it contains, and some of this comes from European countries. How much of it is re-exported cannot be determined, since any important article which has undergone a further process of manufacturing after entering the United States is upon export, reported as a domestic manufacture.

The Fruit Trade.—Mr. Charles H. Fox, of Manchester, directs attention to a rather remarkable survival of protection in connection with the fruit trade, and one particular branch of it. Of the various forms in which plums are imported, the fresh fruit is admitted duty free, dried it pays 7s. per cwt., while for the tinned or bottled kind the 4s. 2d. duty on the sugar in the syrup was exaggerated to a duty of 7s. per cwt. on the total weight of the contents—water, plums, sugar, and all. This injustice, now confined to plums, originally applied also to apricots, but its application was some time ago reduced to 4s. 2d. on the added sugar, and Mr. Fox contends that the reduction should have been applied also to plums. The duty of 7s. per cwt. on plums works out in this way. The English firms bring home a foreign fruit free. They process and tin or bottle it with the syrup, paying in the operation, only the 4s. 2d. duty on the sugar they use, while the same fruit, similarly processed and packed abroad, is kept out by the duty of 7s. per cwt. on the entire contents of the tin. The protective difference which they thus enjoy amounts to about 12½ per cent. in the cost. When the attention of Sir Michael Hicks Beach (then Chancellor of the Exchequer) was drawn to the matter, he replied that "the protective character of the duty was not sufficiently marked to excite the criticism of Mr. Gladstone, nor of Mr. Bright and Mr. Cobden," but it must be remembered that a generation ago the plum import trade was practically non-existent. Mr. Asquith, whose attention has also been directed to the matter, admitted the anomaly, and added that "the question whether the Customs tariff should not be amended in respect of these duties, will receive careful attention."

Tea.—In their last tea report, Messrs. Gow, Wilson and Stanton give some striking figures as to the distribution and price of tea last year and this. For example, Indian tea. In 1906 "dust" averaged 3½d., this year 6½d.; fannings in 1906 3½d., this year 6¾d.; broken tea 5¼d., as against 6¾d.; Pekoe Souchong 5d., against 7½d.; Pekoe 6¼d., against 7¾d.; Pekoe Souchong 4½d., against 6¾d. So with Ceylon. Taking 1906 and 1907, Pekoe Souchong in 1906 was 5d., in 1907 7½d.; and Pekoe 6d., as against 7¾d. The changes in distribution are not less noteworthy. Taking the three months ended March 31, the exports to Austria fell from 48,028 lbs. to 9,751 lbs.; to France, from 85,231 lbs. to 68,174; to Holland, from 36,639 lbs. to 7,400 lbs.; to Denmark, from 31,786 lbs. to 3,585 lbs.; to Spain, from 5,289 lbs. to 480 lbs.; to India, from 405,029 lbs. to 83,860 lbs.; to the United States, from 2,245,437 lbs. to 1,425,470 lbs. On the other hand, the exports to Russia rose from 824,149 lbs. to 2,328,401 lbs. The exports to the United Kingdom fell from 21,042,874 lbs. to 20,351,492 lbs.

GENERAL NOTES.

TOBACCO IN PORTO RICO.—In reporting upon the trade of Porto Rico for 1906 (Cd. 3283), Mr. Consul Churchward refers to the increase of tobacco production and manufacture principally through the enterprise of a large Corporation operating under the immediate influence of American companies. The larger operators have been able to adopt the more expensive methods of growing, curing, and general handling, and consequently have increased the production and improved the quality of the leaf. A large proportion of these crops is grown under cover, the cost of which, although it is said to amount to some £100 per acre, is more than repaid in the enhanced yield and finer quality. These enterprises have had the effect of almost doubling the prices of tobacco lands, and of causing places hitherto considered inaccessible to be taken into cultivation. With the exception of an infinitesimal proportion all the material, raw or manufactured, is shipped to the United States.

PORT SUDAN.—In a report just issued (Cd. 3283) Mr. Hohler, the Second Secretary to his Majesty's Agency at Cairo, gives some interesting particulars as to Port Sudan, the rival of Suakin. The future of Port Sudan depends entirely upon its importance as a port of entry and a forwarding station. For these purposes it has already superseded Suakin, but the old town will die hard, if it die at all. The pilgrim traffic to Jeddah will always pass through it; this year the number of pilgrims expected is about 8,000, and as a native centre it is likely to maintain its position. The lower classes come over to Port Sudan to work, but they return to Suakin to spend their earnings. The dangers which surround the sea approach to Port Suakin do not exist at Port Sudan. The fairway is clear and well lighted, and pilots are available if desired. Pilot dues will shortly be imposed, but as yet there are no harbour or light dues. The harbour is safe, but the wharves and appliances for loading and so-on are not yet ready. Before long, however, the port will be as well equipped as Alexandria. There are at present no bonded warehouses, and the merchants are unanimous in calling for them. Whether the system to be adopted should be that which obtains in Egypt, of one large company, or whether firms should be allowed to establish their own bonded stores, is a question for the Government, but the want is much felt. Port Sudan is already at the head of a railroad running to (1) Atbara, 305 miles; (2) Khartoum, 190 miles beyond Atbara; (3) Kareima, 312 miles beyond Atbara; (4) Wady Halfa, 388 miles beyond Atbara. Other railways are projected, and with every mile that is built, the importance of the harbour increases. It seems destined to become the outlet not only for the immense territories of the Sudan, but also for a great part of Abyssinia, as well as the Congo State.

MEETINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S., Under Secretary to the Government of India, Revenue Department. CHARLES EDWARD HENRY HOBHOUSE, M.P., Under Secretary of State for India, will preside.

APPLIED ART SECTION.

Tuesday evenings, at 8 o'clock:—

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES.

MEETINGS FOR THE ENSUING WEEK.

TUESDAY, MAY 21...Royal Institution, Albemarle-street, W., 3 p.m. Mr. D. S. MacColl, "Alfred Stevens (the English Sculptor and Painter)." (Lecture II.)
Pathological, 20, Hanover-square, W., 8½ p.m. Annual Meeting.

WEDNESDAY, MAY 22..Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

THURSDAY, MAY 23...Royal, Burlington-house, W., 4½ p.m.
Royal Institution, Albemarle-street, W., 3 p.m. Prof. Sir James Dewar, "Chemical Progress—Work of Berthelot, Mendeleeff, and Moissan." (Lecture I.)
Electrical Engineers (at the HOUSE OF THE SOCIETY OF ARTS), John-street, Adelphi, W.C., 8 p.m. 1. Messrs. F. Handley Page and Fielder J. Hiss, "The Present State of Direct Current Design as Influenced by Interpoles." 2. Mr. J. T. Irwin, "Hot Wire Watt Meters and Oscillographs."

FRIDAY, MAY 24..Royal Institution, Albemarle-street, W., 9 p.m. Professor J. A. Fleming, "Recent Contributions to Electric Wave Telegraphy."
North-East Coast Institute of Engineers and Shipbuilders, Westgate-road, Newcastle-on-Tyne, 7½ p.m. 1. The Discussion on Mr. J. L. Twaddell's paper, "Sectional Work in Ship Construction." 2. Captain W. Bartling, "Some Experiments on the Magnetic Character of Vessels."
Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on Holbein's "Dance of Death."
Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.
Clinical, 20, Hanover-square, W., 8½ p.m. Annual Meeting.
Linnean, Burlington-house, W., 3 p.m. Annual Meeting.
Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

SATURDAY, MAY 25...Royal Institution, Albemarle-street, W., 3 p.m. Mr. Arthur Bourchier, "The Limits of the Dramatic Art." (Lecture II.)

The following corrigenda should be made in Mr. P. Schlicht's paper on "The Production of Coke and its Application in Domestic Fires," in last week's *Journal*:—Page 689, col. 2, line 48, for "Aufspitzer" read "Auspitzer." Page 694, col. 2, line 20, for "Schmach" read "Schmacks."

Journal of the Society of Arts.

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FRIDAY, MAY 24, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

NEXT WEEK.

TUESDAY, MAY 28, 8 p.m. (Applied Art Section.) SHERARD COWPER-COLES, "Sheffield Plate and Electro Plate."

THURSDAY, MAY 30, 4.30 p.m. (Indian Section.) LAURENCE ROBERTSON, I.C.S., "Irrigation Colonies in India."

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's - park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club-house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

A programme of the arrangements for the evening will be published in due course.

MULREADY PRIZE.

The Council of the Society of Arts are prepared to offer, under the terms of the Mulready Trust, a Gold Medal, or a prize of £20, for competition amongst students of the Schools of Art of the United Kingdom, at the Annual National Competition to be held in 1908.

The prize is offered to the student who obtains the highest awards in the following subjects:—

(*a.*) A finished drawing of imperial size from the nude living model.

(*b.*) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses (mounted on not more than two imperial size mounts).

(*c.*) A set of studies of hands and feet from the living model (mounted on not more than two imperial size mounts).

(*d.*) Drawing from the life, including memory life drawing done at the Examination in May, 1908.

No student will be eligible for the award who does not pass in the Examination (*d*) in drawing from the life, and who does not obtain an award for (*a*) the finished drawing of imperial size from the nude living model. The other two subjects are optional.

The works must have been executed between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1892, 1893, 1896, or 1903, cannot compete again.

The drawings, &c., are to be submitted, with other school works, in the usual manner to the Board of Education, South Kensington, in April, 1908. Each competing drawing must be marked "In Competition for the Mulready Prize," in addition, to being labelled according to the Regulations of the Board of Education,

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

TUESDAY, APRIL 30th, 8 p.m.; J. C. WEDGWOOD, M.P., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said that the subject of joinery and furniture making was a topic which was very near to them all, because the elements of comfort and of ease in life depended a good deal on the state of their furniture. They all wanted their doors to be quiet in closing; their casements to shut free of draught, their sashes to move silently and easily, and they wanted their articles of furniture, say a chest of drawers, to work without the usual aggravation such things caused, when they were not well made. The tendency of life at the present moment, was rather leading to the extinction of the crafts of joinery and furniture making; he thought the carpenter, the joiner, and the cabinet maker were virtually disappearing over the horizon. The carpenter and joiner was attacked on two sides. The first side, which he might call a double one in a sense, was the very transitory way in which the normal or typical man lived at the present time; he inhabited a house he did not own, only taking it for a term of years, and meaning to get out of it either for better or worse, as the case might be. The things that he put into the house were things he did not care about; the furniture he got for to-day would not suit the smaller or bigger house he moved into afterwards, and so he was content with rather ephemeral products. The pictures on the walls were probably only photographs, the books in his library were borrowed from the circulating library, and all his things generally were placed in the house temporarily. No craft could exist under such conditions; if such was to be the demand, the supply would always remain mechanical. At the present time things were jammed together by hydraulic pressure and kept tight with glue. The other difficulty on the same side, was that those who did care about furniture were full of a kind of crammed-up knowledge of what had been, and they, therefore, insisted on having models made of acknowledged masterpieces. A really fine craftsman ought not to be asked merely to copy. It was quite another thing to tell him he could take inspiration from such masterpieces, to try and absorb the spirit in which they were made, and then produce other articles, but if he were asked merely to copy a thing, it took the starch out of him and left him a limp and disconsolate person. In the end he would probably succeed in making an able forgery, but the forgery would be a lifeless one. The other attack on the craft of furniture-making was an interesting one, namely, from the theoretical medical side. If the doctors were to be believed, people were doing very wrong in living in substantial houses built of good solid material and brickwork, as they harboured the deadliest enemies of mankind in the shape of microbes. The doctors implied that people ought to live in houses which were made of some material which could be very easily and safely burnt at the end of a year or so. It made a great difference to the man who was going to spend his life in constructing articles like furniture when he knew they were to be looked upon as a possession and a treasure of the possessor and his descendants. They all wanted furniture in their houses which they could be proud of, and it was impossible to be proud of any of the usual articles of furniture to be bought nowadays. In olden times people had their pieces of furniture; they spoke of them very respectfully; they treasured them, sought for them, kept them in good repair, and left them in their wills to esteemed descendants. He hoped the information obtained from Mr. Green's lecture would be the means of increasing everyone's respect for furniture, and thereby open up the field for careful thoughtful work, and thus encourage the artificer.

The paper read was—

JOINERY AND FURNITURE-MAKING.

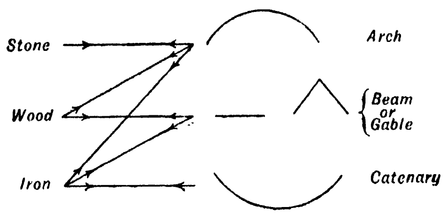
By A. ROMNEY GREEN.

Joinery is one of those crafts which have to do with the building or fitting, the decoration or furnishing of fixed and permanent structures. In this architectural process, it is found that certain materials are better adapted than others to certain purposes. The upright walls of the structure, for instance, can be built of almost anything; but stone or brick are generally used because they are better adapted for the purpose, and much more abundant than any other material, and, by reason of their weight and fragility, are useless for non-architectural purposes. But to use stone or brick for the roof, or the upper floors of a building, is a more questionable and difficult matter. The difficulty consists in carrying the heavy and brittle material under the downward action of the force of gravity, from any one point to another which is not vertically above it. With stone or brick this can only be done, if the two points are any considerable distance apart, by the use of the arch or vault; and this is always an expensive process, whilst in the case of floors it involves a great waste of space and material between the floor and the vaulted ceiling.

But there is another material, wood—light and fibrous, and strong in the direction of its grain, which can easily be carried in a straight line, and therefore with the least possible waste of space or material, from one point to another at some distance off in a horizontal or an

oblique direction; and, since this material is also fairly abundant and quite easy to work, it is generally the best material to use for the roof and floors. Iron (or other metal), the third material available by the architect for structural purposes, differs from stone and wood in that it is much stronger, even in proportion to its weight, though it is also heavier, and in that it is equally strong, whereas stone, as a rule, is equally brittle in all directions, wood standing between the two as strong in one direction alone. For this reason, iron differs both from wood and stone in that it can assume not only the arched and the rectilinear, but the hanging or catenary form, as in a suspension bridge, between one point and another not in the same vertical line. These important properties of the three materials may thus be represented by the following diagram:

FIG. 1.

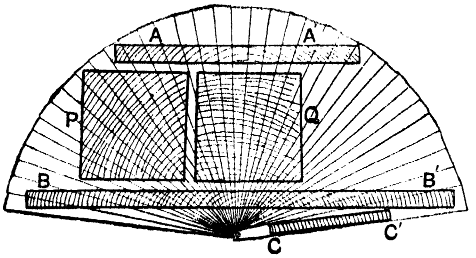


from this it appears that the most characteristic, though not always the only possible, use of each material in solving the given problem is indicated by the corresponding form. Now, it is a principle of the first importance in the architectural crafts that no material should be put to any but a characteristic use; so that in the spanning of aperture, where the catenary for architectural purposes would be worse than useless, iron should have no use at all. A good instance of the violation of this principle may be seen in the entrance hall of the Natural History Museum, South Kensington, where the proportions of the arched system are utterly spoilt by the use of iron, on a scale quite insufficient had these been of the right material, in the uppermost series of arches.

It is in accordance with this principle, to which I shall refer again, that wood may be used, though not in that arched form which is characteristic of stone, for the roof and floors of a building. But the art of using wood thus for structural purposes is the art of the carpenter; not that of the joiner, with which I am dealing to-night. The work of the joiner only begins when the shell of the building is finished; it consists in providing doors, window frames and sashes, handrails, and other permanent fittings. And though in roofing a building we may sometimes hesitate between the stone vault and the timber gable, there is no doubt whatever that for doors and handrails, as also for such portable furniture as chairs and tables, wood, by reason of its strength, lightness and beauty, and of its pleasantness to the touch as compared with stone or metal, is very much the best material.

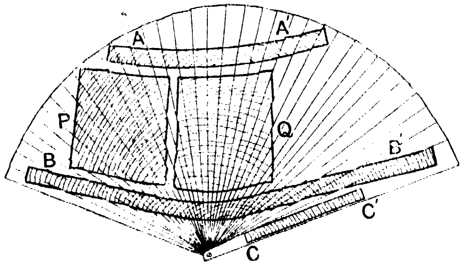
Now the nature of each of the building crafts is of course very largely determined by that of the material used; and wood has several peculiar properties in addition to those which I have already described. One of the chief requirements of a door, which has exactly to fill a given aperture, is that it should remain constant both in size and shape. And one of the most characteristic properties of wood, the material which in other respects it is most convenient to use, is its natural disinclination to constancy either of shape or size. Wood is a fibrous material any prism of which cut with its axis parallel to the grain will be usually of constant length but of variable cross-section. The area of its cross-section, that is to say, will continually decrease as the wood dries, and even after the wood is dry it is sensitive to changes of atmospheric condition, swelling or shrinking as the moisture of the atmosphere becomes more or less. And not only is the cross-section of such a prism variable in area, but also in shape. This is due to the fact that thin laminæ of shell-like cellular tissue are distributed through the substance of the tree at small and fairly regular intervals in planes which pass through the heart; and that these laminæ or medullary rays tend to resist the shrinkage of the wood in the direction in which they lie. These laminæ, that is to say, draw together as the wood dries, but do not very much contract in their own dimensions. As seen in cross-section, where, either to the naked eye or under a microscope, they appear as radii of the annual rings, these rays tend to close upon one another like the ribs of a lady's fan. Some of the results of this tendency are illustrated in my first slide (Fig. 2). The card fan is to represent the cross-section of an oak tree out of which have been cut, whilst the wood is still green, the three flat boards, AA', BB', and CC', and the two square posts, P and Q. As the wood dries the medullary rays—the leaves of the fan—close upon one another thus, with the result that the boards, AA' and BB', contract in width

FIG. 2.



and become convex towards the centre or heart of the tree. These deformations are more pronounced in AA', and in the middle of BB', where the rays cross it obliquely; whilst CC', and the outer parts of BB', which lie in the direction of the rays will hardly be deformed at all. The square posts, moreover, are no longer square, P, which the rays cross in the direction of its diagonal, being further deformed than Q, which the rays cross in a direction parallel and perpendicular to its sides.

FIG. 3.



My second slide shows two actual cases of these deformations. It also shows a square post which contains the heart of the tree, and in which, since the medullary rays cannot close up all round the heart without somewhere opening a crack in the log, we find the expected crack opening, as we should expect, between the heart and one of the nearer surfaces. There are cracks also on other sides of the log, but these are due to the fact that the log dries from the surface inwards, and they will close up again, whilst the other shake will open still further as the log continues to dry; and there are cracks called "heart-shakes," starting from the heart but not reaching the faces of the log, which would have been there when the tree was first cut down, and which I will not try to explain.

From these examples of the curious behaviour of wood we can draw some important morals. If, for example, a post which the rays cross diagonally is to form the leg of a table it should be set so that the rays are tangential, and not normal, to the circumscribing circle; for on this will depend whether the outside shoulder joints between the leg and the rail opens or not as the leg dries. But the most important moral of all is that which relates to the cutting of a flat board, especially when it is most desirable, as in the case of a table top, that the board should neither warp nor shrink. In this case, as you see on reference to the model, the board should be in a plane which lies as near as possible to the heart of the tree, though on one side or other of the part nearest the heart, so that the medullary rays are as nearly as possible parallel to its surfaces, as they are in this illustration. For when thus cut the board will have little inclination to warp, and its shrinkage, as the rays close upon one another, will affect the thickness, where it can not be great, rather than the width of the board. And here is an admirable instance of the poetic justice of Nature; which generally contrives that what is rightly done from any one point of view shall be rightly done from every other; and in particular that the requirements of use and beauty shall be satisfied at the same time. For it is when the board is cut in this way, that the rays, if they are visible at all, crop out most beautifully on the surface, as they do here, in great flakes and splashes of light; and, strangely enough, there is one wood, oak, in which the rays are much more plainly visible than in any other, and it is just this wood which is more liable than any other to warp and shrink when improperly cut. Moreover, the board is more easily sawn out or rent, and very much more easily planed up, when it is cut in this way; so that there are three important reasons, any one of which would be alone sufficient, for cutting as many boards as possible out of an oak log in this way rather than in any other.

I will show you, then, how this may be done, assuming that we wish, as we naturally should do, to cut boards of various thicknesses out of one or any number of trees. But first let me show you how an oak tree is generally cut up by an English timber merchant as an example of how it ought not to be done. We are justly proud of our English oak as the finest timber in the world; but I am sorry to say that if we see an oak tree cut up in the right way we may be almost certain that it was not cut up in England. One thick plank, containing the heart shakes, is cut out of the middle of the tree, because, they

say, boards cut here would be useless on account of the heart shakes; and the rest of the log is cut into boards parallel to this plank. The consequence is that only two or three boards on each side of the plank—only five or six altogether out of the whole tree—are cut in the right way; and that the thick plank, though it may be used for fencing or other outdoor work, is almost useless to the joiner, as it is penetrated with shakes throughout. But it is just where they take this thick plank that we can cut the best figured, and, but for the heart shakes, the most valuable boards; and since a long heart shake, which may spoil half the thick plank, will only spoil a small part of each of the thin boards, this is clearly the right thing to do; cutting the thinnest boards we want, for door panels, &c., out of this part of the tree, and so making the best possible use of it. As soon as we are clear of the heart shakes we can cut thicker stuff to be used in larger pieces for table tops, &c.; above and below these we cut two sets of boards in the vertical plane, narrow but beautifully figured, and exactly suitable for the stiles and rails of doors or other framed structures; and outside them again we can cut table legs or other posts, though remembering their tendency to deformation as the wood dries. This is merely an intelligent variation of the ordinary Continental and American method of cutting wainscot oak, cutting it, as they say, "on the quarter."

I will now return to the question of door making, in connection with which I can illustrate most of what I have to say on the subject of joinery. From what I have said you will see that it is impossible to make a good door of a single board, even when sufficiently wide stuff is available. It would shrink, it would warp, and it would be very liable to split longitudinally if subjected to a violent shock in slamming, or by a determined house-breaker. The problem here, as in every wooden structure, is to obtain that strength and constancy of dimension in all directions which the material possesses in one direction alone. This may at first be attempted by screwing or bolting other pieces of wood with the grain horizontal—ledgers as they are called—to one side of the original wide board. But even so the tendency of the latter to shrink will probably result, either in its splitting, or in its buckling the ledgers; for the strength of this tendency is almost inconceivable till one sees the effects of it. The next attempt, therefore, to solve the problem, will be by making the width of the door in several pieces, bolted, as before, to horizontal ledgers, but with tongued and grooved or over-lapping edges, so that the pieces may shrink separately without buckling the ledgers, or showing daylight between their joints. In this case, however, the door will obviously require bracing; the lapped edges of the vertical members will afford a good opportunity for moulding; and we get at last a door such as that shown in the following slide. This is the first type of a thoroughly good door. It will always be popular on the score of cheapness, and is actually often preferred for its intrinsic merit to the next and more elaborate type. My own objection to it is that on the side on which I cannot see the construction I wish that I could, and on the side on which I can see it, it is generally so clumsy, that I wish that I could not. The fact, moreover, that its construction involves the use of bolts or screws gives it just the same inferiority to the next kind of door that a packing-case has to a chest of which the sides are dovetailed.

The great virtue of the framed and panelled door is that its construction is visible on both sides; that it is highly characteristic of the material, and that it does not involve the use of any other—it can be made without screws or nails. The most elementary form of such a door consists of five pieces of wood, four thick narrow pieces, grooved on their inner edges, and mortised and tenonned together, to form the frame, and one thinner and usually wider piece, the panel, fitting into the grooved frame. I have here a sample of such a door in process of being put together. The mortises are usually cut on the vertical members of the frame, the stiles, and the tenons on the horizontal rails. Here, if the groove is deep enough, and the panel does not quite touch its inner surface, it is clear that the panel is free to shrink or swell without leaving or deforming the framework, the inner edges of which will form a rectangle of constant size; and if the stiles are sufficiently narrow, the tendency to alteration of the whole width of the door will be much less than that of a single board of the same width.

Before describing the possible elaborations of this simple form, I must call your attention to certain small points which should be observed in construction. The tenons may either be carried right through the stiles and fastened with wedges, as in the specimen, or carried only part way through, when they are called stub-tenons, and fastened with wooden pins. The former is the strongest,

and in modern joinery the most usual, method, but it has this danger: that if the stiles are not quite dry, they may shrink away from the shoulder, leaving an open joint which disfigures and weakens the door. The usual recipe for providing against the opening of the shoulder joints is to say that the wedges should be so cut as to fit more tightly at their inner than at their outer ends. A safer precaution, however, is to put saw cuts in the tenon and insert the wedges in these cuts, instead of outside the tenon, as in the next slide; and either to use glue on the wedges only, or, at all events, to see that there is no glue on the upper and lower edges of the tenon at its outer end. In this case the tenon is really dovetailed into the stile instead of being merely held by compression, as it is by the usual method; and if the stile shrinks, it is just as sure to shrink towards the shoulder rather than away from it, as a ball is to roll down hill rather than up. If, however, the wedges are placed in the usual way, it is a good plan to use glue on their inner surfaces only, so that they become part of the tenon rather than of the stile, with the same advantages that are obtained by the other method.

By the use of intermediate members of framework, vertical, horizontal, or oblique—rails and muntins, or struts and braces—with the requisite number of panels, this type of door may be elaborated to any extent.

Here are some examples of doors and other panelled structures from the Victoria and Albert Museum kindly lent by the Board of Education, which I have arranged in chronological order, with the purpose of illustrating and trying to explain the extraordinarily rapid change in the spirit and art of wood-working, as in the other architectural crafts, which took place between the fourteenth and eighteenth centuries.

All manual or productive work is of two kinds, which may be distinguished as the indirect and the direct, or as the preparatory and the creative. To sharpen a chisel, for instance, is work of the first kind; to use it work of the second; to make a door is work of the second kind; to draw the door, or to make any mere instrument of production, such as a mitre-board, is work of the first kind. And corresponding to these two kinds of work there are two extreme types of workmen. There is the enthusiastic and hot-blooded, the foolish and poetic, type of workmen, who is in such a hurry to get to the creative work, that he will spend the least possible time over any preliminary operation, and that not till the last possible moment; he will sharpen no tool till he actually needs to use it, and make no working drawing, nor waste his time upon any time-saving contrivance, if he can possibly do without it. And there is the conscientious and methodical—shall I say the diplomatic or prosaic?—type of workman, who has realised that time well spent in preparation may be more than saved in the actually productive work; who makes sure that his tools are all sharp and in order, his working drawings and templets complete, and every possible labour-saving expedient considered and prepared, before he touches the wood at all; who cuts out all his parts before he begins to plane them, and fits them all together before he will carve or mould them; and who adheres strictly throughout to his working drawings, whether they are his own or another's. These are the two extreme types of what I may perhaps call the natural and the civilised craftsman; the one with his attention wholly fixed on the end desired, and working directly to that end with such few and simple tools as he already possesses; the other constantly considering the means to be adopted, and working therefore with continually more numerous and complex instruments; the one wholly possessed by his conception; the other equally content, so long as it gives him an opportunity of using his latest and most ingenious tool, in working at that of another man; the one, therefore, freely and fully expressing himself in the finished product of his labour, by which alone he is finally judged; the other expressing himself, by the way, in many practically unrecorded activities, and producing finished work of a less human and individual character because of the more specialised and mechanical nature of the tools employed.

The moulding plane, which has been so much used on these last two doors, is a good example of what I mean by a highly specialised tool. I do not know the date of its introduction, but it was certainly long subsequent to the introduction of mouldings. Look again at the old pew ends, or at the old pulpit*, and you see that they are covered with mouldings for which the moulding plane could not have been used at all. For the moulding plane can only move in a straight line, and cannot very well be stopped until it gets to the end of the wood. It might have been used, for instance, to cut

* Photo 15947 in S.K.M. catalogue.

the moulding on this rail, but not that on the stile, which must have been cut with chisels and gouges, in order to turn the corner in that way. Indeed, the whole thing is obviously the work of men who were quite content, on the one hand, with these simple tools, and whose heads, on the other hand, were so full of patterns that no two of the carved panels, nor of the vertical moulded ribs, are anywhere of the same design. And though you will probably not think that any of the detail is as good as it might be, you will all admit the charm of mingled richness and rudeness, the vast amount of individual character, that there is in the whole effect. The expression of character is direct. It is impossible to imagine that this pulpit was designed by any but the man who made it, or that full-sized working details were drawn out even by him. Rather it grew as he worked at it, and his work was spontaneous and direct. He had not studied nature, this man, nor had he been taught design, but he seems to have been born with the tools in his hand, and ever since to have been dreaming of leaves and feathers, and knotted tree trunks, and half human, half bird-like, inhabitants peering at him from between the branches. Except, perhaps, in this one panel, which seems to be of later date, he worked mainly to please himself, with the result that the whole thing is alive, and still instinct with the soul of its forgotten author.

This fine old door (S.K.M. 18261)—also French—is of about the same date, and of very much the same character; but there is one premonition of the coming change in that the plough has apparently been used on the framework of the door in the capacity of a moulding plane, though the device of making this mechanically cut moulding continuous by means of mitreing has not yet been attempted.

In this seventeenth century panelling (S.K.M. 19305), and in this next (22041), an eighteenth century door, it is clear that a complete change has come over the spirit of woodworking. This change may be partly explained — or shall I say, more fully described?—by saying that the craftsman has begun to prefer the more complex and highly specialised to the simpler tools. He has begun to realise that time spent on the preparatory stages of his work may often be more than saved in the actually creative processes; he has learnt to work with a deliberate and increasingly elaborate adaptation of means to ends in which his genius has more than half expressed itself before the work of creation begins. He has found, for instance, that if he buys or makes himself a moulding plane he can cut mouldings of a certain kind, very much more quickly and accurately than he could do with the gouge and chisel. And, since his moulding plane will not go round a corner, he has begun to mitre his mouldings. And for this purpose he finds that he wants a mitre-box and a specially fine-toothed saw; and that even then his mitres have to be planed, so that he must make himself a mitre-board, and for that, again, a particular sort of plane.

Now all this has an effect on the craftsman's character. Between the use of a moulding plane and of a gouge or chisel there is all the difference between work and play. Leave a man with a sharp chisel alone in the same room with a sharp-edged rectangular board, and he will be just as irresistibly moved to attack the sharp edges of that board with his chisel as the boy to notch the edges of the school desk with his knife. To hack with something—with anything—at all sharp edges and corners is an instinct of the human race. But I do not think I ever yet met the natural man who was irresistibly attracted to the use of the moulding plane. The moulding plane is a very different instrument from the pocket-knife or the chisel. These latter a man can use very effectively for a short time in a certain way, and then use them quite as effectively in some other way, or, if he is inclined to be lazy, stop using them altogether. But when he begins to use the moulding plane on the sharp edge of his board, he must either at once or in a succession of strokes go the whole length of that edge; and he must go the whole length of that edge many times, his moulding plane traversing always exactly the same path at exactly the same inclination to the face of his board, to produce an effective moulding. This is something very like hard work; and when the moulding is cut, the workman—unless he also made or designed the plane—has not expressed himself, except, if he has been successful, by his fidelity to the conception of another man. His work has been mechanical, and the result is highly mechanical as compared, for instance, with the richly-cut ribs of the French pulpit. And before he can make such a door as either of the two last—for the sake of brevity I will call the section of Jacobean panelling a door—this mechanical operation has to be many times repeated; and, worse than that, his plane will have to be

frequently sharpened. To sharpen a knife, a chisel, or a gouge, is a simple, and by no means a disagreeable task; but to sharpen the iron of a moulding plane so as not in the least to alter the delicate contour of its edge, which must everywhere project exactly the same small distance beyond the shaped sole of the plane, is the task of a mechanic, a slave—or shall I say of a saint? — rather than of an artist and a free man. Of the true artist, as of the poet, we must say that he is born, that he is not made; but the exact contrary is true of the kind of artist who can turn out such doors as those. Not only the cutting of the mouldings, but the mitreing of their corners, whether "stuck" as in the one door, or "planted" as in the other, and the construction of the whole door, is mechanical, unimaginative, and tedious to the last degree. And it is especially interesting to notice—only in looking at the photograph of these panellings I did not at first notice sufficiently—how this mechanical and unimaginative character of the craftsman which is fostered by the use of such instruments as the mitre-board and the moulding plane, comes out also when he handles—or wishes it to appear that he has handled—the superior tools; for his attempts at decoration on the Corinthian pilasters and on the central panel, (S.K.M. 19305) which, as far as the tools are concerned, might have been freehand, are just as hard and monotonous as his plain flat panels and his painfully cut and mitred mouldings. Even his patterns do not express the man, but have obviously been traced and repeated — so at first I thought — from the full-sized drawings of some academic designer. But here perhaps I did an injustice to the academic designer, and I certainly underrated the sophisticated ingenuity of the artisan. For on looking more closely I see that very little of this decorative work has been done with the carving tools at all; it has been cut out with a fret saw and glued on to the structural members, some of the rosettes only having been afterwards carved so as to heighten the artifice by which I was at first deceived. And here, you see, some of this applied ornament is peeling off, in obedience to the natural law which always at last exposes the artificial and insincere.

So far I have only partly explained this great change which has come over the spirit of wood-working. I have been careful to give the technical explanation only. I have explained it as a tendency to the specialisation of tools, the elaboration of means and methods, the spending of thought and time and energy on preparatory rather than on creative processes. I have said that the craftsman expresses himself in the instruments, the bye-products of his activity, rather than in those more enduring results by which alone he is finally judged, since these are all the while the true end of his labours; and that the finished product of his work would be naturally less human, less richly interesting, more formal and mechanical, merely on that account. Whether or not the later work is also less beautiful is perhaps a question of individual taste. A great deal of beautiful work, especially in furniture making, was done during the seventeenth and eighteenth centuries; and, speaking generally, I do not wish you to think me prejudiced in favour of Gothic as opposed to Renaissance art. I only ask that all art shall be natural and good; not consciously—it can never be that—but quite unconsciously the expression of character, as undoubtedly is the work of the great painters and sculptors of the early Renaissance period; and as often was that of the eighteenth century furniture makers when they used their improved appliances to produce work which was, not cheaper, but really better and more useful, than that which had gone before. And so far I have only said that the specialisation of tools has a strong tendency to make this expression of character less direct—the finished products of the tool less human and alive. But I do believe, too, that the arts are well called the "humanities," and that the more beautiful of two works of art is always the more human or humane. Everywhere and in everything, in our houses and in our furniture, as well as in our books or our friends, I believe it is life, it is soul, which we look for, and by which we live. I believe, therefore, that the change which I have traced in the art of wood-working is decadence—is a change for the worse. And if you agree with me, and if you are content with the explanation I have tried to give—if we assume that the craftsman as a free agent has been himself responsible for the tendencies I have just described—then we must believe that every art contains in itself the seeds of its own destruction. This, however, is not only a most unhappy, but a most unwarrantable conclusion. This rapid decadence of the crafts which has characterised the western civilisation of the last four or five hundred years is anything but a normal phenomenon. In Egypt and Asia the

industrial arts have often flourished for untold centuries, or even thousands of years, without any such signs of diminished life and energy as have been traced in these illustrations. And, to come nearer home, here is a Norwegian chair of the tenth century (S.K.M. 23713), and here a Norwegian butter-tub of the eighteenth century; and the spirit that breathes from these two lovely works, separated though they are in date by eight hundred years, is so nearly identical, their difference of functions allowed for, that they might almost have been made by the same man. Here, on the other hand, is a French chair (the ugliest thing I could find in the South Kensington Museum—26488) of almost the same date as the beautiful French door, but instinct and hideous with an utterly different feeling, which, since it is carved all over, and must at that time have been carved by hand, cannot be wholly accounted for by the specialisation of instruments.

If we go back again over our illustrations, you will see, I think, that those which I have already attributed to the natural or poetic type of craftsman as opposed to the civilised or prosaic, and to the direct as opposed to the indirect method of workmanship (and with these I include the Norwegian articles), resemble each other, but differ from the two later doors, as also from the French chair, in that they bear no witness to the existence either of academic influences or of class distinctions. We have here, in fact, two distinct kinds of art—the two kinds of art which Mr. Lethaby, I believe, lately distinguished as the "distributed" and the "condensed," but which, since I was unfortunate enough not to hear his paper, and do not wish to misapply his terms, I had better continue to call the natural and the civilised, or might describe better still, perhaps, as the voluntary and the forced. The first, the natural or voluntary kind of art, is done on their own initiative by the people for the people; by the craftsman for his own family or township, for his church or his Guildhall; at the worst—or shall I say, at the best?—for some local magnate or liege-lord with whom he had personal contact, and between whom and himself on both sides was recognised a social tie; and if the Norwegian chair was made, as it should have been, for a king, that king was, like his subjects, a viking; he was much more truly, I imagine, one of his people than were the kings of the Middle Ages. But the two later doors and the French chair, though by no means worthy of kings, bear internal evidence, as it seems to me, that no social tie was recognised at all between those who made them and those for whom they were made. They bear witness to an over-emphasis of class distinctions which is just as fatal to art as it is to manners and conversation in begetting everything that is over-formal or over-florid at the expense of everything that is natural and sincere; and which is even more fatal to art than that tendency to the over-specialization of tools which I have already described. The freedom of execution, the geniality of the earlier work, as compared with the formality or floridity of the later, is the geniality and freedom of the man who is working, not only with simple rather than with highly-specialised tools, but for kindred spirits of his own acquaintance rather than for unknown task-masters of greatly superior rank, and different habits of life. Of such an unknown task-master it is naturally assumed by the humble craftsman that he will require in all his furniture and apurtenances an almost superhuman perfection of workmanship, whether simple or ornate; he cannot imagine that this superior creature is possibly a man of like tastes with his own, who might be wonder-struck by the same half-suggested beauty or charmed by the same conceits.

The decadence of Gothic art is a mysterious phenomenon, and there are doubtless many people in this room who know more of its history than I do. I am only anxious, if possible, to absolve the craftsman; I am sure that he was not solely responsible; that there were social causes at work, and that these were at first political rather than academic or economic. But with the Renaissance of art and learning the craftsman became subject to another and more far-reaching than this political tyranny; to that of antiquaries, scholars, and architects who, in a spirit of noble though mistaken enthusiasm, deliberately proceeded to force on him traditions utterly foreign to those which he had himself developed. To impose on the craftsman of one age and country the traditions of another utterly dissimilar in climatic and social conditions would always be fatal to his own genius and to his dignity as a free man; but it was especially so in our own case because the usurping traditions were those of the slave-holding communities of Greece and Rome and favoured our already existing bias to formality and mechanical finish in that they had been adjusted by tyrannical masters to the capacities of the helot races. In what

I have called voluntary art, the craftsman, as I have pointed out in the case of the oak pulpit, was obviously his own designer; though in this capacity he made no painful effort to be original; his individual genius was always partially subject to the authority of his great traditions; and the importance of this principle, that the craftsman should be his own designer, whilst subject to his own traditions, it is impossible to over-estimate. Even by the draughtsman himself a perfect design can never be made on paper; a design, in fact, can never be said to be made until it is carried out. A hundred opportunities occur during the progress of a work of art for improvements and modifications, for just those little touches that make the whole difference between success and failure, which cannot be foreseen until the work is actually in progress. No true craftsman will ever adhere exactly to a cut and dried set of full-size working details, even of his own design; he will be continually revising his first conception according to the promptings of his spirit, the weakness of his flesh, or the stubbornness of his material, as he goes along. If, for instance, he has intended to use a large piece of wood for a certain purpose and finds that he has not got it, he will probably make a virtue of necessity, and a pattern of his small pieces. If, in cutting out a bracket or angle piece, he finds that the grain of the wood permits a sharper curve than he had hoped for, he will alter his design accordingly. And thus, by taking advantage of his opportunities, accommodating himself to his material, working always in the direction of least resistance, he will produce an article of a certain natural, inevitable, almost fatal beauty, superior to that of his own more arbitrary first conception. It is this slow evolution of types, and adaptation of forms to materials, this constant elimination of everything that is unfit either from a decorative or a constructive standpoint, that constitutes a sound tradition; and such a tradition can only be developed and maintained by successive generations of craftsmen who are their own designers, and who are also in direct communication and sympathy with the public for whom they work. The work of the professional designer, carried out by the mere mechanic, may usually be known by one or more of the following characters: by that symmetry and formality, and dull repetition of parts, which saves so much labour in drawing, and takes so much interest out of the creative process; by that cheap originality or eccentricity which is so easy to the man who has substituted pencil and paper, for the stubborn material and the cutting tool, and who is not therefore compelled to suffer in his own person the penalties of his own caprice; or, at the best, by a certain violence of intention, an abuse of material, and waste of labour, which suggest the strategist who conducts a campaign, not from the saddle but from the arm-chair, and without sufficient reference to the movements of the opposing forces. Beauty in art, as in nature, is organic; it is seldom either quite geometrical or quite capricious; it grows, it cannot be manufactured; its manifestations are not to be compelled but awaited; like the kingdom of heaven, it cometh without observation. And till this principle, that is, that the craftsman must be his own designer, is thoroughly grasped and applied we can have no national art.

I have now attributed the decadence of the crafts, previous to the industrial revolution, to three co-existing tendencies; to the specialisation of tools, the over-emphasis of class distinctions, and the growth of academic influences, and it was merely the more rapid development of these tendencies, following the invention of the steam-engine and power-driven machinery, which constituted the industrial revolution. Not only the tools are specialised but the workman's functions; the man often becomes not a tool merely, but a veritable machine. And this inhuman degradation of the craftsman, who was once in the full exercise of his creative faculties, perhaps the most nearly godlike of all God's creatures, is justified in the name of economy; and this though the average national income per head has doubled and trebled and, perhaps, quadrupled itself since the golden age of mediæval art and handicraft. The result we know. We know what fabulous sums are now given for old pieces of furniture, because persons of taste will pay anything rather than tolerate in their houses the abominations of modern furniture. We know what these people suffer because there were some things which our forefathers did not make—how they cannot enjoy the use of a billiard table, a grand piano, a roll-top writing table, or even a comfortable chair without importing into their museums of art elements of vulgarity and discord which might very well break their hearts. We know how almost impossible it is for us to restore an ancient building without spoiling it so utterly that it would have been better destroyed. We

know how at the first contact with western commerce and civilisation the arts of the great peoples of Asia, or of the more remote peasant races of Europe, which had flourished, as I have said, with undiminished energy for hundreds or even thousands of years, are suddenly withered away as if by magic, and beyond hope of revival. And even when, independently of economic considerations altogether, we put forth our best powers to produce work, let us say, for the great Paris Exhibition, this is the kind of thing we do. (S.K.M. 22350, 22358).

Various attempts are being made, as you know, to remedy this state of affairs. Here, for instance, are some illustrations of the work of Mr. Sidney Barnsley, who makes, as I think everyone will admit, the best furniture that is now being produced at all. Mr. Barnsley makes the strongest possible protest against modern industrial methods, not only in eschewing the use of all machines, and, of course, in designing his own work, but in executing it throughout entirely with his own hands. But all work in applied art is the work, not only of the individual craftsman, but of the whole community; and in spite of their richness and fine proportions the formality of these two beautiful cabinets suggests, I think, that Mr. Barnsley has not the confidence in his public which would enable him to let himself go; to express himself with the freedom and geniality of the mediæval craftsman. Mr. Barnsley, in fact, like everyone else who is trying to do good work at the present time, and who has also to make a living at it, has to work for a rich class of very refined and superior people; for people with whom the craftsman, or anyone who works with his hands even if he belongs to their class by birth, as now-a-days he often does, can have very little in common. For when a member of this class begins to work with his hands; when he begins to see life from the real, the industrial, side—from the point of view of the people who produce the necessaries of life—the things without which the superior and ornamental class could not exist for a day—he soon finds that his whole outlook upon things in general is suddenly and strangely transformed. What was important to him is now trivial, and what was trivial is now important. In particular a whole class of things which were formerly almost beneath his notice—chairs and tables, and cups and saucers, and pots and pans, and wheelbarrows and ladders, speak to him now continually; they have become biographies and histories, of the joys and the sufferings, the virtues and vices, of their makers, his fellow men. He suddenly realises that it is the producer, and not, as he used to be taught, the consumer, who is the important person. If he is a furniture maker, he finds that he wants to make furniture for other people who also work with their hands; for the kitchen rather than for the drawing-room, and for the farmhouse or the town hall—rather than for the town flat or the residential villa. So that when I said that the decadence of the crafts was very largely due to the over-emphasis of class distinctions, I might have put it more simply and said that it was due to the fact that people have stopped using their own kitchens themselves. I have neither the time nor the temerity to drive this point home this evening; nor am I qualified to preach a theory that I do not practise; but I merely give you the facts.

Less than a hundred years ago, the Norwegian peasant, before his economic man had been tempted and his taste corrupted by the wares of the British capitalist, produced kitchen and other furniture for his own use of which this butter-tub is an example. And when Mr. Barnsley, instead of making drawing-room furniture for other people, makes furniture for a kitchen which he himself uses and lives in—for a living-room—a room which is a study and a library as well as a dining-room and a kitchen—he makes furniture like this for it. Even this furniture, beautiful and interesting though it is, is severe and plain as compared with mediæval work; but that only illustrates the difficulty of the craftsman who has to start from the beginning on his own account. Had Mr. Barnsley inherited four out of these five pieces of furniture, the time and energy expended on the five he might have put into one alone. Each piece, probably, would have been richly carved; and that the more easily and successfully because the inheritance of living traditions would have been even more valuable than that of the furniture itself. All art tends to be both expensive and artificial in the absence of true traditions, because then the craftsman must stop to think before he can act, which takes time, and is in any case a dangerous habit; and this loss of tradition is even more fatal to decorative than to structural excellence. It is for this reason that wood-carving is almost a lost art at the present time, and one, I believe, which Mr. Barnsley has not tried to revive. I have the

greatest admiration and respect for the work of Mr. George Jack; but wood carving in his hands is a fine art; I feel that it is almost too refined and beautiful; it is work that it would be hopeless to emulate, that could never become traditional, and that, in any quantity, would be almost oppressive to live with. I feel that if it is yet possible that the art of wood carving in an architectural and popular sense of the word be revived at all it must be rather in the spirit of my friend Mr. Godfrey Blount. It is much less refined and elaborate work than Mr. Jack's, but full of irresistible life and energy. It is nearer to the mediæval work in spirit than almost anything I know, just because it is play rather than work. The tools used are of the fewest and simplest, and the technique easily acquired. The only thing that is not easily acquired is Mr. Blount's genius for pattern-making, which is, unfortunately, the important thing. Mr. Blount's work is seen at its best on the beams and lintels of his own house. But even when he works for other people he has still this curious predilection of the true craftsman, for making kitchen and nursery utensils—spoon-racks and salt-boxes, and cradles, and so on—he makes no drawing-room furniture—he works for the working people.

All these unorganised efforts at reform, such as Mr. Blount's and Mr. Barnsley's, serve, in fact, to show that any real revival of a national art and handicraft involves legislation; involves, especially, the better payment of the people who do the work of the world. I only wish to insist that something ought to be done; and I cannot do better than conclude by quoting to this effect so great an authority as Plato:—

"Such qualities" [viz., 'of a mind that is really well and nobly constituted in its moral character'] . . . . "enter largely into painting and all similar workmanship, into weaving and embroidery, into architecture, as well as the whole manufacture of utensils in general, ... for in all these things gracefulness or ungracefulness finds place. And the absence of grace, and rhythm, and harmony, is closely allied to an evil style and an evil character; whereas their presence is allied to, and expressive of, the opposite character, which is brave and sober-minded. . . . .

"Ought we not therefore to extend our superintendence to the professors of every craft, and forbid them to impress those signs of an evil nature, of dissoluteness, of meanness and of ungracefulness on any work of their hand; altogether interdicting such as cannot do otherwise from working in our city, that our guardians (aristocracy) may not be reared amongst images of vice, as upon unwholesome pastures, culling much every day by little and little from many places, and feeding upon it, until they insensibly accumulate a large mass of evil in their inmost souls? Ought we not on the contrary to seek our artists of another stamp, who by the power of genius can trace out the nature of the fair and the graceful, that our young men, dwelling as it were in a healthful region, may drink in good from every quarter, whence any emanation from noble works may strike upon their eye or their ear, like a gale wafting health from salubrious lands, and win them imperceptibly from their earliest childhood into resemblance, love, and harmony with the true beauty of reason."

DISCUSSION.

Mr. H. H. Statham heartily agreed with the author in all he had said about the manner in which craftsmanship had degenerated. Nowadays a man, instead of designing and carrying out the whole thing, was engaged in mechanically making only one portion of an article. He also agreed with the author in thinking that the introduction of so much machinery had done very much to ruin the artistic spirit in the work. He could not, however, agree in Mr. Green's theory that the workman was only to work for those of his own class, and that the art was killed if he made things for people in a higher station of life. That theory was contrary to all history, and while the author talked about art having been killed by the exaggeration of class distinction, the facts were all the other way. For the last 200 years they had been breaking down class distinctions. The author had referred to the Italian Renaissance; but who were the people, who made a great deal of the beautiful work then produced, making it for? They were making it for persons entirely above their station. It would be seen, if one looked at the autobiography of Cellini, that even he produced work to please princes and poets, and sold that work to them. He (Mr. Statham) did not see that it was a higher theory of art to make things only for one's own class. If a man wanted to make beautiful things he would put his best work into it, whoever he was making them for. The audience had been shown that evening, some earlier specimens of wood work made before the specialist tools appeared, and he quite agreed that such work was much more interesting, and that there was more of the mind of the worker in it, but some of that work, especially the Norwegian chair, looked to him a little clumsy. He could not see why there should not be good art combined with what one might call elegance and finish, such furniture as that of Chippendale and Sheraton, which he called furniture with a distinction about it. He could not understand

the passion for kitchen chairs and tables at the present time, he thought they might very well be kept for the kitchen. He himself preferred in his drawing-room fine and graceful furniture.

Mr. EDWARD SPENCER remarked that the author had lamented the incursion of an alien art into England at the time of the Renaissance, and had rightly attributed to that incursion the cessation of continuity in tradition, which was so important in the arts and in the crafts. Another effect of their incursion was the gradual severance of the functions of design and execution, which went to make what might be called the drawing-room art of the present day. But one could not help recognising the fact that at the time when the Renaissance art was brought into England from Italy, after travelling through France, westwards and northwards, the tradition as it existed then in England was not a very healthy one. Gothic art was in its decadence, and it was because of this decadence that it allowed the Renaissance, the classic, the foreign art to usurp its position. The reason that Gothic art was then in its decadence was, he thought, because those institutions which were designed to protect the crafts and the privileges of the craftsmen had themselves began to suffer from the shock of quite a new and antagonistic force—the force of capitalism. It was because it was so essential that in a modern State they should not only have fine crafts, but also institutions designed to protect the development of those crafts, that he should like to quote Mr. Hobson, who said in his book, "The Social Problem," that it was not enough to have a changed heart in the community in order to ensure reform, but it was necessary to have the forms—Mr Hobson meant the political forms—that fitted them. For that reason he (Mr. Spencer) endorsed the author's opinion, that the relationship between politics and art was a very close one.

Mr. A. ROMNEY GREEN, in reply to Mr Statham, said that theoretically, class distinctions were less now than in the Middle Ages, but, practically, they were greater; there was a social tie recognised between the upper and lower classes in the Middle Ages which was not recognised in the same way at the present time. With regard to Cellini he should say that his art was a fine art, and he (Mr. Green) had not been talking in his paper about fine arts—painting, sculpturing, and so on; Cellini would rank as a sculptor, not as a furniture maker. With reference to Mr. Statham's criticism of the eighteenth century furniture, he would point out that the makers then were, as a rule, their own designers; whereas in joinery, in making doors, and so on, the designing of such things was done by architects. That was the reason why the eighteenth century doors were decadent, but the furniture of that period was not.

On the motion of the CHAIRMAN, a hearty vote of thanks was accorded to Mr. Green for his paper.

THE RESOURCES OF SPITZBERGEN.

When the islands of Spitzbergen were first discovered by Dutch sailors in the year 1596 they were found to be without inhabitants, but abounding in game and fish. A station was built at Smeerenberg on the south-easterly coast of what is now known as Dane Island. Dutch whalers visited the islands in great numbers for a long time, and as time passed Russian, Norwegian, British, Swedish and Danish fishermen and hunters also found the remote region worth visiting. Of late years the Norwegians are the people who pay most attention to this field. In the year 1906 six different Norwegian whaling expeditions with crews aggregating 420 men, made their stations there. Besides these a great number of smaller craft from towns of northern Norway visit the islands every summer, hunting and fishing; some hunters also pass the winters there. The cargoes brought home consist principally of oils, furs, and eider down. The aggregate yearly outcome is estimated at about £100,000. A few years ago it was discovered that coal of fair quality appeared in various localities. Experimental mining has been conducted by several parties, and during the past winter no less than three well-established and equipped expeditions, aggregating more than 150 men, remained in the islands. In the largest of these a good deal of American capital has been invested. Game such as reindeer, polar bears, ptarmigan, geese, ducks and other birds are still fairly plentiful in the islands, but as no one is in control the fauna are being wantonly exterminated, being killed at all seasons of the year. One of the visitors there last summer reported that a party of tourists killed upwards of 100 reindeer, leaving the carcases where they fell, only bringing away with them a few of the finest heads and antlers for mounting. The eider duck is so tame while hatching that it may often be lifted by hand while the nest is robbed of down and eggs. In Norway stringent laws have been enacted for the protection of this valuable bird. It is stated on good authority that the walrus by this time is nearly extinct, the white whale which was formerly very abundant, is becoming scarce, the numbers of seals and polar bears are largely reduced, and that the reindeer and birds are being killed at all seasons and are becoming exterminated. No nation has yet taken possession. It would seem high time for the nations most directly interested to come to an understanding whereby the islands, including Bear Island, either were formally turned over for annexation to one certain power, or else that a combination of the powers would make arrangements whereby law and order could be maintained, game and fishery laws made and enforced, and mining claims protected. The prospect for paying coal mining is good, and the claim is made that indications of valuable minerals are present. Tourist steamers of different nationalities visit the islands every season. The warmest part of the year is the first half of August, when the thermometer sometimes reaches 60 degrees Fahrenheit.

HOME INDUSTRIES.

The Railway Companies and Wages.—There is no immediate likelihood of a strike of railway servants for higher wages, but the men are making preparations that suggest the probability of their pressing their demands before many months have passed. Reference was made in these notes last week to the agreement arrived at between the Engineering Employers' Federation and the Engineering Trade unions, and to the admirable example it sets to other trade organisations. But between the present position of workmen in the engineering and railway trades there is an important difference. The Engineering Employers' Federation recognise and treat with the unions, the railway directors do not, because there is no body sufficiently representative of the men to warrant the directors in assuming that it speaks for the great majority of them. A year ago the Amalgamated Society of Railway Servants consisted of 60,000 men, or only 28 per cent. of the total possible number of men in the grades represented by the society. It was not unnatural that railway directors should decline to admit that a society representing so small a percentage of the total body of the men was really representative. It is true that during the present year, owing to exceptional efforts, there has been a large increase in the membership, which has brought the proportion of the men who are members of the society to 38 per cent., and the membership is still increasing rapidly, so rapidly that if this increase continues for another few months the society will be in a position to claim that it speaks for the majority of the men. The railway servants enjoy some advantages over similar *employés* in other trades. Their employment is continuous, and they are as safe in it as a civil servant, whilst some of them receive pensions when too old to work, and many get tips which add materially to their wages. But as a body they have grievances, the principal of them perhaps being the question of hours. And here the public interest is very directly concerned. The question of Sunday labour is a branch of the same grievance and should not be incapable of satisfactory settlement.

Bankruptcy in 1907.—The number of bankruptcies may be taken as a rough index of the state of trade. According to this test trade is in a comparatively satisfactory condition. During the three months ended March 31 the total number of bankruptcies was 1,083, as compared with 1,254 in the corresponding month of 1906, and 1,317 for the three months ended March 31, 1905. The reduction is more noticeable in the High Court than in the County Court cases.

The Boot Industry.—The boot manufacturers are grumbling loudly at the continued high price of leather. They have not yet been able to obtain an adequate advance in prices, and they complain that their margin of profit has disappeared. The demand is for light boots. Even the working classes are discarding heavy footwear. But this demand for light boots makes matters worse for the manufacturers, as light leathers are the dearest and most difficult to obtain at anything like a reasonable rate. The demand for them comes not only from boot manufacturers, but also from glovers, the motor trade, bag and belt manufacturers, and others, and the supply is not equal to it. High-water mark was thought to have been reached at the Leeds leather fair, but since then small transactions have been recorded at higher rates. It was thought that prices would recede to something like their former level when the exceptional influences of recent years—the war, the famine in India, the disturbance in the Chicago stock yards—had ceased to operate, but the growing demand was underestimated, and instead of abundant stocks and falling prices leather is still scarce and dear. Supplies are increasing, but the demand increases more rapidly, and there seems little likelihood of any substantial fall in prices. None of the many substitutes for leather in the market can equal it in its hard-wearing and damp-resisting properties. The inventor who discovered such a substitute would be a public benefactor.

Insurance and the Cotton Industry.—The Federation of Master Cotton Spinners' Association has adopted a scheme for insuring "sprinkled" cotton mills against fire, and are considering another for the covering of risks under the new Workmen's Compensation Act, which comes into force on July 1. With two unimportant exceptions all the accident offices have now agreed upon a tariff which binds the several companies to minimum premium rates. In mule spinning the official rate is 15s. per £100 of wages paid, for ring spinning 4s. 6d., and for weaving 4s. 6d. Employers are dissatisfied with these rates, considering them excessive, and steps are, it is understood, being taken to make other arrangements of a special nature to cover the liability of cotton spinners under the Act.

Fast Colours.—A discussion in the *Manchester Guardian* on fast colours has led to an interesting letter from Mr. W. M'Farlane, of Miller's Brook, Heywood. "Fastness," as Mr. Heywood points out, is a relative term, no two colours being capable of withstanding the same test to exactly the same degree. This is why it is so difficult to formulate a test which shall satisfy all requirements. For commercial purposes colours must be tested according to the specific uses to which they are to be put. A colour satisfactorily "fast" for one purpose may be quite unsuitable for another. Fast colours in the laundry sense are colours that will stand washing and bleaching. Up to recent years the only colours of this class were turkey red and indigo blue, and even the latter was somewhat overrated, losing, as it does, the major part of its substance under

bleaching, and sometimes, unless the dyed shade be very dark, disappearing altogether. Now, thanks to the researches of colour chemists, it is possible to produce a quite extended range of shades which fulfil the present exacting requirements, and which really deserve the name of "fast" colours. This is especially the case with blue, which can be made not only much brighter but infinitely faster to bleaching materials and lighter than the old indigo. The skilled dyer now produces "fancy" shades of equally stable character, and practically as durable, as the fabric into which they are woven.

British Insurance and San Francisco.—In referring to the great fire in San Francisco, Mr. Consul-General Bennett says that amongst the defaulting companies there does not appear the name of a single British corporation. From a return made by the insurance companies, it appears that the amount of insurance written in San Francisco in 1905 by 92 companies was very nearly 756,000,000 dols., whereas the amount written in 1906 was 890,000,000 dols. The premiums taken by companies, American and foreign, which maintain their reputation for honourable dealing in the recent disaster, have increased largely. The Consul-General puts the general average at practically 50 per cent., but one English company has increased the amount of premiums taken in the past year from 300,000 dols. to over 800,000 dols., whilst another has increased from 300,000 dols. to over 600,000 dols. This business is now distributed not amongst 223 companies, as was the case in 1906, but amongst 92. "It is gratifying to notice," writes the Consul-General, "that with very few exceptions, and those owing to complications caused by the earthquake clause and its doubtful interpretation, the English companies have fully maintained their reputation for prompt settlement of losses, and that they are now reaping a rich harvest in new insurance work in San Francisco, at considerably higher premiums than were charged before the fire."

The Wheat Harvest Outlook.—There would seem to be some ground for the recent advance in the price of wheat, and the belief that the world's wheat harvest will be a short one. In the United Kingdom the plant looks well in most districts, but, unfortunately, nowadays the home output is too small to have much effect upon prices. Elsewhere—in the countries from which the United Kingdom obtains the larger part of her wheat supplies—the present outlook is disturbing. In the United States, according to the Washington Bureau, 3,500,000 acres of winter wheat have been "winter killed," and it is expected that the winter wheat crop will be about 100,000,000 bushels less than last year, whilst the condition of the spring wheat is described as very unfavourable in North Dakota and North Minnesota, consequent upon the extremely late season. The reports from Canada are not more favourable. In Manitoba and the Canadian North-West spring sowings had hardly commenced on May 1st owing to the inclemency of the weather, and a late season spring wheat crop seldom gives a heavy yield in those districts. The strange character of the weather during the past winter seems to have been general not only in America but in Europe. In Russia, from which so much of the wheat consumed in the United Kingdom is got in these days, semi-official reports put the damage to autumn wheat in the districts where it is mostly grown at from 5 per cent. to 50 per cent. The Spring wheat crop was sown late, and owing to the unfavourable weather the condition of the crop is precarious. In Roumania the official reports speak of a loss of 25 per cent., and unofficial estimates put the 1907 crop at 50 per cent. less than that of 1906, when the wheat crop yielded 13,600,000 quarters. In Austria-Hungary, the Argentine, Australasia, and India, crops promise average yields, but nowhere is there a surplus. Of course, the weather of the coming months may materially alter the present outlook, but probabilities point to a considerable shortage in the world's wheat crop in 1907, and, so far as the United Kingdom is concerned, the supplies are believed to be much smaller than usual.

The Income Tax and Cotton Spinners.—The Federation of Master Cotton Spinners' Association object to the proposed new regulations relating to income tax assessments, more especially to the abolition of the three years' average clause so far as it affects cotton mills. Cotton spinners also contend that it would be unsatisfactory to them to have assessments made by the Surveyor of Taxes instead of the Income Tax Commissioners.

OBITUARY.

SIR BENJAMIN BAKER, K.C.B., K.C.M.G., F.R.S.—The Society has suffered a serious loss by the death of Sir Benjamin Baker, one of its Vice-Presidents, who died suddenly at Pangbourne on the 19th inst. Sir Benjamin was elected a Member of the Society in 1884, and became a member of the Council in 1888. In 1900 he was elected a Vice-President, and held the office till 1903. He was again elected in 1906, and remained a Vice-President until his death. In February, 1889, he read a paper on the "Forth Bridge," and several times took the chair at meetings of the Society, the last occasion being at the reading of Major Baden-Powell's paper on "Aerial Navigation" on the 17th of April last.

Sir Benjamin had achieved a great reputation as an engineer, and at the time of his death was certainly regarded as the head of the profession in this country.

The work which made his reputation as an engineer was the Forth Bridge, in which he was associated with Sir John Fowler, at that time his senior partner. This and the Barrage of the Nile will always be considered his most important works, though there are besides these many which would have sufficed to make a reputation for a smaller man. His engineering labours were recognised by the grant, first of the K.C.M.G. and then of the K.C.B. In 1895 he served as President of the Institution of Civil Engineers, and in 1890 he was elected a Fellow of the Royal Society. He was in his 67th year at the time of his death.

GENERAL NOTES.

CHANGES IN ROME.—Within the last 37 years Rome has been almost rebuilt. A map of 1870 compared with one of the present time will show that its topography has altered considerably. Strenuous efforts are being made to establish manufactures. The possible harnessing of a portion of the Tiber, and of the waterfalls near Rome, as a motive power, the recent 50 per cent. reduction on the important duty on petrol, the proposed reorganisation of the electric supply service, and other reforms of a wide public character are expected to assist to this end. In his report upon the trade of Rome in 1906 (Cd. 3283) Mr. Consul Morgan says that complaints that Rome has been spoilt by the obliteration of some of the traces of the past are not, in his opinion, well founded. "All that could be preserved of the past of Rome was most scrupulously saved, and even now important schemes are under official consideration for the protection of the city's monuments." Mr. Morgan says that Rome is gradually becoming an important market for the sale of works of art. Visitors give extensive orders for copies of old masters existing in the Vatican galleries as well as the Capitoline museums, or belonging to private collectors. The exportation of old works of art is checked on account of the Government restrictions, which are getting every year more stringent, local public opinion being decidedly against the exodus of what is looked upon as the national artistic patrimony.

MEETINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock:—

MAY 30.—"Irrigation Colonies in India." By LAURENCE ROBERTSON, I.C.S. CHARLES EDWARD HENRY HOBHOUSE, M.P., Under Secretary of State for India will preside.

APPLIED ART SECTION.

Tuesday evening, at 8 o'clock:—

MAY 28.—"Sheffield Plate and Electro-plate." By SHERARD COWPER-COLES. SIR JOHN EDWARD BINGHAM, Bart., will preside.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, MAY 27...Geographical, University of London, Burlington-gardens, W., 3 p.m. Annual Meeting.

British Architects, 9, Conduit-street, W., 8 p.m.

Medical, 11, Chandos-street, W., 8½ p.m. Annual Oration.

Victoria Institute, 8, Adelphi-terrace, W.C., 4½ p.m. Rev. F. Stores Turner, "Mencius."

TUESDAY, MAY 28...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. (Applied Art Section.) Mr. Sherard Cowper-Coles, "Sheffield Plate and Electro-plate."

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 7.50 p.m. Annual General Meeting. 8¼ p.m. 1. Mr. F. H. Campbell, "Contributions to the Chemistry of Gold." 2. Dr. F. Mollwo Perkin, "Reduction of Oxides, Sulphides, &c., by Means of Metallic Calcium." 3. Dr. T. M. Lowry will Exhibit Thermostatic Apparatus.

Royal Institution, Albemarle-street, W., 3 p.m. Professor G. H. Nuttall, "Malaria, Sleeping Sickness, Tick Fever, and Allied Diseases." (Lecture I.)

Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.

Statistical, 9, Adelphi-terrace, W.C. 5 p.m.

Photographic, 66, Russell-square, W.C., 8 p.m. Messrs. C. E. Kenneth Mees and J. K. Baker, "Measurement of the Efficiency of Dark-room Filters."

Zoological, 3, Hanover-square, W., 8½ p.m.

Horticultural, Vincent-square, Westminster, S.W., Annual Flower Show in Temple-gardens, E.C.

WEDNESDAY, MAY 29...British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

Colonial Institute, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Mr. J. Burtt-Davy, "Agricultural Possibilities in the Transvaal."

THURSDAY, MAY 30...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4½ p.m. (Indian Section.) Mr. Laurence Robertson, "Irrigation Colonies in India."

Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Sir James Dewar, "Chemical Progress—Work of Berthelot, Mendeleeff, and Moissan." (Lecture II.)

FRIDAY, MAY 31...Royal Institution, Albemarle-street, W., 9 p.m. Mr. A. H. Savage Landor, "Recent Journey across Africa."

SATURDAY, JUNE 1...Royal Institution, Albemarle-street, W., 3 p.m. Sir William White, "The Contest between Guns and Armour." (Lecture I.)

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ALBERT MEDAL.

The Council of the Society, with the approval of His Royal Highness the President, the Prince of Wales, have awarded the Albert Medal for the current year to the Earl of Cromer, O.M., G.C.B., G.C.M.G., K.C.S.I., "In recognition of his preëminent public services in Egypt, where he has imparted security to the relations of this country with the East, has established justice, restored order and prosperity, and, by the initiation of great works, has opened up new fields for enterprise."

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club-house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

A programme of the arrangements for the evening will be published in due course.

PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked, "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1908, when six prizes are offered for competition, each prize to consist of a bound copy of Owen Jones's "Principles of Design," and the Society's Bronze Medal.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday afternoon, May 2, 4.30 p.m.; SIR CHARLES A. ELLIOTT, K.C.S.I., LL D., in the chair.

The CHAIRMAN, in introducing the reader of the paper, said that Sir Edward Buck occupied an eminent position in all matters concerning agriculture and irrigation. He (the Chairman) first became acquainted with him more than forty years ago, when he was in charge of the Cawnpore Model Farm, which was one of the first institutions established to enable English officials to obtain information about native methods of cultivation before they tried any reforms or improvements of their own. After that he was associated with the author in the settlement of the Farukhabad district, where they studied together the work of the canal system, the fertilising power of its waters on the crops, the injury done by the water if efficient means were not provided to carry it off again, and the remarkable effect it produced by liberating the labour of thousands of men and cattle from the drudgery of drawing water from the wells and distributing it in a minute trickle over the fields. Afterwards, when Sir Edward became Director of Agriculture, he took up a number of interesting projects, such as the producing of silk in Dehra Dun and the growth and manufacture of tobacco in Ghazipur and Pusa. His greatest achievement of all was his standardisation of the system of cadastral survey, and the creation of a permanent record of rights, automatically corrected year by year by the village accountants. Since he resigned the service he had not lost his interest in India, having revisited it every year to keep himself abreast of all that was going on in the way of progress and reform; and now he came before the Society to offer a most valuable contribution to their general knowledge by showing what Italy had to teach India in the use and control of water.

The paper read was—

THE APPLICABILITY TO INDIA OF THE ITALIAN METHOD OF UTILIZING SILT.

By SIR EDWARD CHARLES BUCK, K.C.S.I., LL.D.

On the 7th of June, 1904, an agricultural conference held at Ravenna in North Italy passed the following resolution: "That whereever fertilizing silt is available it is a grave economical error not to profit by it." I ask you to accept this resolution as the text of my address.

I have had some hesitation in deciding whether to begin by talking about India or about Italy. Perhaps the simplest plan will be first to indicate briefly what India has done to utilize silt, then to describe what Italy has done, and finally to suggest the further possibilities in India.

Let me first explain how my own attention was drawn to the subject. Sometime after the first Provincial Department of Agriculture in the Upper Provinces was committed to my charge, I visited an estate managed by an English planter on the banks of the Ganges, who, among other improvements, had controlled the drainage on the summit of the cliffs, and by a system of small dams across the gullies, supplemented by terracing, checked the further erosion of the uplands; held up the silt carried by the drainage, and quadrupled the letting value of the land.

Returning with this object-lesson in my pocket to the provincial farm near Cawnpore, I took in hand a small area of broken, raviny, and mostly unculturable land close by, and began "doctoring" it with dams and drains much in the fashion of a boy playing with sand on a seaside beach, but was removed from the province before I had seen more than the commencement of the slow process of silt deposit. An intelligent native assistant, however, had watched and appreciated the proceedings, and carrying them on after my departure eventually asked for and received permission to rent from the proprietors the broken and neglected lands of the neighbourhood, which he succeeded in transforming into a profitable estate, of which the rental has been more than quadrupled. He is still, in 1907, extending further afield the system which has made him, after retirement, a prosperous farmer. As long ago as 1892 my successor, Mr. Holderness, wrote to him as follows: "You have clearly shown that by embankment and a very moderate outlay on manure it is easily possible to improve broken and apparently sterile land and convert it into fertile fields. Until I saw your work I had not realised how valuable the simple expedient of embankment is."

Later on, I came across in Gwalior, a State as large as Ireland, an interesting illustration of the value of silt. There Colonel Pitcher, once my assistant, then the administrative factotum of the Maharaja, had enclosed the catch basins of large areas by low banks sometimes a mile or two in length, which focussed the drainage towards a strong

dam, so as to form a small lake from which the rice fields *below* the dam were irrigated. When the water was drained off at the beginning of the winter, it was found that the silt deposited *above* the dam gave magnificent crops of wheat, and this notwithstanding the fact that the drainage had been drawn from the poorest of soil, and from stoney hills in which only low scattered scrub could grow.

In my further tours through India I ascertained that in many localities the advantage of capturing and utilizing silt was appreciated by cultivators, who did their best to secure it on a very petty scale, but I did not find that any important attempt had been made in the same direction by the authorities.

What I had seen and heard led me in 1893 to obtain permission to issue a circular to all provinces asking for the facts. The opportunity was taken to circulate an extract from Scott Moncrieff's "Irrigation in Europe," in which he described, to use his own words, "the enrichment of a barren and worthless valley in the Moselle country by no manure save the alluvial matter deposited by abundant irrigation," and the question was asked whether anything of the sort had been done in any Indian province.

The replies were received just as I was leaving India. I have them here, and they are of great interest. They indicate

1. That in many localities cultivators appreciate the value of silt.
2. That, with or without financial assistance, they take action of a petty character to secure it.
3. That action is mainly confined either to the damming or terracing of broken land, or to the swamping of rice lands with silt-laden water.
4. That in a great part of India no practice of any kind prevails.
5. That nowhere, with very few exceptions, have the authorities themselves undertaken any important scheme.

There is no time to go through the replies province by province, but I may quote the first (that from Madras) as a sample :—

"Except in four districts," it was written, "no action has been taken of late years to promote the construction of dams or for fertilizing by silt deposit. There is little or no information regarding the practice of ryots, but they are in the habit of making small dams for preventing erosion, or in rice fields to bank in water for the deposit of silt."

In other provinces whatever encouragement is given to cultivators is for petty works of similar character.

We are told, too, of the reclamation of salt-lands on the Bombay coast; of the flooding of some lands on the Indus; of the terracing of small tracts below the salt range; and of the silting up of a few depressions by canal officers in the Punjab, in all of which operations the authorities have interested themselves. But these cover but an insignificant area compared with that of India. We are told, on the other hand, by the Agricultural Department of Upper India, that in 13 sub-Himalayan districts, say 30,000 square miles, where it is written the system described by Scott Moncrieff, might well be carried out, nothing has been done either by the cultivators or by the authorities to arrest the silt.

Such was the position in 1895. It has hardly been affected by anything that has been done since, except, perhaps, in Bombay, where the damming of ravines and gullies has been encouraged as a famine relief work.

My own attention was not again drawn to the subject until June, 1905, when I had the honour to represent the Government of India at the Agricultural Conference at Rome. This gave me the opportunity not only of learning something of what had been done in Italy in the way of capturing silt, and of receiving invitations, private and official, to come and see how it was done, but also that of discussing the subject with Lord Minto, who led the British representatives at the Conference. I did not then know that I was talking to the future Viceroy of India, but the circumstance led, perhaps, to the mission with which Lord Minto's Government charged me in 1906 to visit Italy and to submit a report on their methods. I may indeed say that but for Lord Minto's interest in the subject I should not be addressing you this evening.

I will now ask you to follow me to Italy, and learn with me something of the great work—viz., the control and utilization of drainage streams and rivers—which has been carried on in that country for centuries, but never with so much energy and so effectually as at the present time.

I may at once say that I met with the most cordial reception at the Ministries of Public Works and of Agriculture; that I was made acquainted with all official and other literature on the subject; that I was given introductions to the engineers on the principal works which I wished to visit, as well as to the agricultural and chemical professors at the Universities;

that the engineers themselves gave me the fullest assistance and instruction; and that the University professors provided me with much useful information.

From no one did I receive greater kindness than from Count Pasolini, whose grandfather, the great statesman and an equally great agriculturist, was an intimate friend of Lord Minto's grandfather, with whom he stayed in Scotland. Count Pasolini volunteered to take me to Ravenna, where he is continuing the work of his grandfather in improving his large estates, as are other proprietors in the neighbourhood, by overlaying the lower lands with a deep deposit of river silt. I will not attempt to describe my tour except to say that the most important works which I visited were those at Ravenna, conducted by landowners, and those at Capua and at Grosseto, conducted by the Government, as well as many in which operations had been completed. I have only time to give you a general—bird's-eye—view of what has been, and is being done in Italy.

History shows that in the utilization of the waters of their rivers for various useful purposes the Italians have long given lessons to the world. For some centuries past they have taken the utmost pains, quoting their own phrase, "to put the bridle on" one after another of their streams. It was at the end of the twelfth century that, following the lead of their Roman ancestors, they began to turn their rivers into canals, of which the objects were to carry irrigation to the agricultural lands and potable waters to the towns. Two of the most important of such works in operation at the present day were constructed not less than seven hundred years ago. But the supply of irrigation and pure drinking water were not the only objects for which they harnessed their streams for, as time went on, they found that they could, to quote one of their writers, "use the waters of a river as a weapon of defence against the destructive and pernicious influences of the very river itself." Leonardo da Vinci, whose genius as an engineer was even more remarkable than his skill as a painter, had been among the first to point the way. The heading of the fifty-third chapter of his great treatise on the "Movement and Measurement of Waters" is "How with the running waters we ought to carry the earth of the mountains into the valleys, so as to render them fertile, and to purify the air." And for the last five centuries the intelligence of the Italian engineers has been directed to forcing each stream to turn the swamps which it had itself caused into fertile plains, and to build up with its own silt rich terraces in the very ravines which it had torn from the hillsides.

It is interesting to learn from Italy to how many useful purposes the drainage of a country can be directed when once it has been brought under control.

There is an extensive Italian literature on the subject, but the most recent and comprehensive works are two published as lately as 1902 and 1904, by Engineer Niccoli, Professor of Agricultural Chemistry at the Pisa University. Omitting domestic uses and the like his divisions of the agricultural uses of controlled water are:—

1. Irrigation, or the supply of water to crops.
2. Fertilization of land by irrigation.
3. Fertilization of land by submersion.
4. Protection against frost by submersion.
5. *Bonificazione* in the plains.
6. *Bonificazione* in the hills.

I will deal as quickly as I can with the first four on the list, for it is to the last two, Bonificazione in the plains and hills, to which I wish to draw attention. But I must explain the meaning of Bonificazione. (It is to me a more blessed word than Mesopotamia.) I can, however, suggest no one English word as its equivalent. In paraphrase it means in the plains the fertilization and sanitation of low-lying unhealthy lands by deposit of silt combined with drainage; it means in the hills the utilization of silt and the prevention of erosion.

Returning now to Professor Niccoli's list:—First, irrigation of crops—well, we know all about that in India. In no country has a more splendid work been accomplished than that of our engineers, second to none in the world, in the bridling of the great northern rivers and in using their captured waters for the irrigation of crops. But it is interesting to remember that they, too, carried to India an object-lesson from Italy. Three of the leading pioneers of our Indian canal system, Cautley, Baird Smith, and Scott-Moncrieff—great names—travelled through Southern Europe to study the irrigation works and methods of France, Spain, and Italy, learning lessons, specially from Italy, which have been applied not only to India, but in later years also to Egypt.

The next subject is the *fertilization of land by irrigation*. This can only be done when the water contains fertilizing material. The pro-

cess is, in a sense, silt depositing, but it is only a veneer of silt, and can be applied to land either prepared for or bearing crops. The extension of the practice is strongly urged by the agricultural authorities. Thus writes a professor of the Pisa University, in his advocacy of the practice:—"The silt of the river Arno contains, weight for weight, as much fertilizing substance as would be obtained from half the amount of stable manure, and can be easily utilized for irrigating cultivated land."

The third subject is *fertilization of land by submersion*. This process, as in India, is chiefly applied to rice lands. But Professor Niccoli goes further, and shows with the aid of diagrams a plan on which it is carried out on gradually descending levels, systematically arranged for the purpose. He refers also to the Nile system, which includes fertilization of land both by submersion and by irrigation. And I have received, from Sir Thomas Elliott, a note courteously prepared for me by Mr. Sabin, of the Board of Agriculture, showing that the practice has, under the name of "water meadows," prevailed in some parts of England where the value of the land has often been increased tenfold by the process. It is interesting too to learn that Arthur Young, the father of agricultural reform in England, introduced a method not unlike the "gradually descending" plan of Professor Niccoli; and that later on an improved system was advocated by, among others, a former Secretary of State for India, Sir Stafford Northcote, who gave a description of it, as long ago as 1852, in the "Journal of the Royal Agricultural Society." The area of water meadows in England is said to be about 100,000 acres.

The system of "warping," which implies the spreading of fertilizing water on the deltas of rivers when the incoming sea tide turns back the river flow, is also described by Mr. Sabin, as practised on the Humber and elsewhere, and I can only regret that the time allotted to me does not permit me to give further details of either water meadows or warping.

I must deal quickly too with the next subject, *Protection against frost by submersion*. All of you who have travelled through Lombardy in the winter, must have seen on either side of the train what appears to be a serious inundation extending as far as the eye can see. These are the so-called "*marcite*" meadows in which grass and other herbage is protected by water, innocent as I found, of silt. The sole object of the flooding is protection from frost. Even in India the market gardeners hurriedly run water over fields occupied by valuable crops when frost is expected. And with reason. For in view of the fact that the vapour of water is known to be more impermeable to heat than almost any known substance, it can readily be understood that a stratum of moisture temporarily raised over the crop prevents heat from escaping from the soil.

We now come to the main subject of our discourse, *Bonificazione in the plains*. The blessed word includes on one hand the drainage of water-logged tracts and on the other hand the building up (*colmata*) of low-lying lands by river silt. These are the two measures with which the Italians have sucessfully banished malaria from some thousands of square miles of their country. To anyone to whom the knowledge of the facts is brought for the first time both the magnitude of the work and the patience with which it has been and is being executed must be the cause of surprise and admiration.

A splendid reward has been reaped. For Bonificazione now directed primarily against malaria at the same time confers upon the land such exceptional fertility that tracts in which man could hardly live or gain a livelihood are to-day crowded by a prosperous peasantry.

The history of Bonificazione is a long one. It began with the drainage of marshes by the Romans. But no comprehensive schemes were undertaken until the twelfth century, when measures were commenced for the amelioration of the historical "Val di Chiana," supplemented later on by the treatment of some hundreds of square miles in other localities, notably between Pisa and Florence. It is interesting to know that the first to study the question of silt deposit to which the reclamation of the Val di Chiana is due was Torricelli, a pupil of Galileo. The valley comprises about 800 square miles, of which no less than 500 have been built up by silt, but it was not until the end of the eighteenth century that it was authoritatively announced that malaria had been finally expelled from the valley. "All the transformations have been due," says the official report, "to the natural deposit of silt spread over the land by branch streams directed more or less by man."

In an interesting report of 1903, the first of a series under issue by the Italian Parliament, the history is commenced of the whole series of Bonifcazione works now in progress. It is

prefaced by a brief but instructive account of the running fight against malaria during recent centuries. This shows that a careful study made long ago of the conditions under which malaria prevailed proved emphatically that they were the very conditions which medical discoveries have since established as necessary for the existence of the mosquito. But the cause not being then recognised, popular and medical prejudice strenuously opposed the piling up of river silt, the decaying matters in which were, it was contended, a dangerous source of the malady. Nevertheless, the State engineers persevered and later medical science has proved them to be right. "Now," writes the author of the report, "the new school of medicine welcomes Bonificazione, of which silt deposit is the main feature, as the sovereign remedy (*remedio sovrano*), at the same time that it is financially beneficial."

We may pass now from the centuries preceding to the period succeeding the Unification of Italy in 1862. Although in the first few years political interruptions interfered with progress, yet by degrees a comprehensive scheme was launched for gradual Bonificazione throughout the whole of Italy. I will not attempt to follow the changes in legislation which experience showed from time to time to be necessary for the object in view, but will commence with the latest Act of 1900. This Act confers upon the State the right of undertaking the Bonificazione of all unhealthy lands, whether private or public, the exercise of the right being justified, states the Act, by the necessity (1) of lessening the difficulties of police supervision; (2) of removing the causes of malaria. The first object is explained by the fact that bandits and criminals have been in the habit of taking refuge in malarial swamps where the police are afraid to follow them. So it is in the malarial Terai of North India.

To return to the Act. Bonificazione is divided into two so-called "categories." The first category includes important works of drainage and silt building conducted by the *Government*. The second category, those in which private interest is (*a*) dominant, (*b*) exclusive. These are conducted by *private agency*.

Expenditure on works of the first category is divided in the following proportions. The State pays 6-10th, the province 1-10th, the commune 1-10th, and the proprietor 2-10th. In the (*a*) class of the second category, if any hygienic result at all can be proved, the State may award 1-10th, and the province and commune each 1-10th as a grant in aid. In the (*b*) class province and commune are not precluded from assisting. The enhanced value (*plus valenza*) of the improved land accrues to the proprietors, subject only to the ordinary land tax in all cases.

We may now pass to some very interesting figures, which indicate the magnitude of the campaign against malaria. In the last 42 years expenditure has been 221,000,000 of lire, or £9,000,000 sterling.

In 1903 the area then under treatment by Government agency is recorded as 4,300 square miles, of which 1,800 square miles has been finished, and 2,500 square miles are under execution.

The map exhibited shows the position and area of each work in progress. It will be noted that they are distributed over every part of Italy.

These figures do not include the work done before the unification, such as the Val di Chiana. There is no record of that area, but I believe that 3,000 square miles would be below the mark. Nor do they include the numerous works of the second category, such as the Ravenna estates. The area of these is not known, and I can only state that private owners are now so satisfied with the financial advantages of the silt system, that the practice is widely spreading. And it must be understood that even the works of the first category are not to be limited to the above record. As engineers are released from one scheme they will be put on a new one not yet included in the schedule. I was officially informed that unrecorded projects for Sardinia alone, involving mainly silt deposit, will take in about three-quarters of the island. A low estimate of the area, past, present, and future, might be 10,000 square miles, or about 1-10th of the area of Italy.

The question will be asked, What is the commercial aspect of Bonificazione? The answer is that all writers, early and late, testify to the profitable results of the *colmata* profits, of course varying with local conditions and the character of the silt. In one tract of 100 square miles which I visited, the benefit was made out to be 20 per cent., while in another district returns of private enterprise carefully examined by a Commission, showed it to be, as a rule, something like 25 per cent. Instances occur of enormous profit, such as an estate formerly worth 700 francs, selling for 50,000; but such exceptional cases are no guide. It is true that some of the older works, handicapped by

political interruptions, by inexperience, and by injudicious financial arrangements, resulted in loss. But, as the engineers all told me, "If they had known then what we know now, there would have been no loss." All round financial advantage may perhaps be safely estimated at 20 per cent.

I am referring here to the *colmata* or silt-built land, not to drained land, which is much less remunerative. In recent years a tendency has prevailed to lower the level of the water rather than to raise the level of the soil, because, say the engineers, and with reason, we can expel malaria far more quickly by drainage than by silt. But this view has put the agriculturists up in arms, and a somewhat acute controversy has been recently proceeding between them and the men of the public works which may be said to have been more or less concluded at that Ravenna Conference of 1904 by a resolution of compromise, which, while admitting the hygienic advantage of rapid draining, urged that where possible drainage should always be followed by deposit of silt because, and here came our text, *it was a grave error not to profit by fertilizing silt whenever it was available*. The Conference concluded by advocating the formation, as in Germany and in France, of a corps of agricultural engineers whose training and sympathies would promote agricultural as well as purely engineering interests.

I should detain you too long if I were to attempt to describe in detail the process and methods of silt building. Broadly speaking, the captured rivers or their canals are led into embanked enclosures, each of which may be a few square yards or a few square miles in area, on which silt-bearing water is allowed to lie until its silt has been deposited. The pen of an engineer is required for a further description, and more than 50 pages are devoted to the subject in one of Professor Niccoli's treatises. Many factors have to be considered; the slope of the ground; the character of the silt; the depth of the required deposit; the drainage system of the locality, and so on.

Much, as I have said, depends on the amount and value of the silt which the river carries. Very careful analyses are accordingly made by chemical experts of the silt taken from the river when in flood at various depths, and various distances from the banks. From some rivers, as at Ravenna, the silt is only worth taking immediately after heavy rains in the hills, which perhaps only occur six or seven times in the year, and even then the deposit of silt is confined to a few hours on each occasion. The river Volturno, on the other hand, near Capua, is much richer, and can be utilised more often and for longer periods. Progress in the former case is slower than in the latter.

A few words now about "Bonificazione in the hills." The system of reclaiming ravines and rugged hills is known as *colmata di monte*, or building up of the hills. This is carried out by private owners, not by the State, who cannot in this case plead the hygienic object. A long history is attached to the gradual development of the system. The earliest plan was the primitive practice of terracing, such as we are familiar with in the Himalayas, and, indeed, in mountainous regions throughout the world. But this method affords little protection against the gradual erosion of soil torn away into gullies by heavy rains and torrents. Here, again, Leonardo da Vinci was first with his advice, thus worded: "to break the ravine torrents by watercourses branching in various directions." Gradual modifications, which it is needless to describe, were made during succeeding centuries, until about 100 years ago, when in the hills between Pisa and Florence, the land agent, Testaferrata by name, of the Marquis Ridolfi, worked out a system described by one writer as a "stupenda invenzione," and which is now accepted both as fulfilling da Vinci's precepts and as the most perfect plan of dealing with gullies and rugged hills yet devised.

The following description was given of the system in my report to the Government of India:—

"The 'Testaferrata' system is described in a treatise by the grandson who has succeeded to the Rudolfi marquisate; also by Professor Niccoli, who devotes 40 pages to the subject; and more elaborately still by an agricultural professor, Conti; in each case with the aid of exp'anatory diagrams, wi hout which indeed it is difficult to give a clear account of the methods employed.*

"The following general remarks taken with little modification from Niccoli's 'Agricultural Uses of Water' may be useful:—

'The buildings up of the hill (*colmate di m nte*) have for their complex object the utilization of the force of the waters for the removal of the objectionable ruggedness, whether convex or concave, and for modifying or making more uniform the slopes. The waters act in a twofold manner—(1) by eroding the projections and convexities and carrying away earth

* M. Conti, "La sistema e lo scuolo delle acquè dei terrini di collina" (Casale, 1903).

from them; (2) by transporting and spreading the silt into depressions and concavities. The hills which lend themselves most readily to the system are those with rounded summits which supply a sufficient amount of rain water to the ravines. . . . . The first thing to do in order to prevent disastrous erosion is to surround the upper portion of the hill or slope with a trench succeeded lower down by similar horizontal trenches from which streams are conducted in any required direction. This is in effect the principal preached by Leonardo da Vinci in the chapter quoted in paragraph 1 of this report.' Professor Niccoli then enters into technical calculations which show that in a hectar of land ($2\frac{1}{2}$ acres) with a slope of 150 feet, 30 inches of rain in the year will give a force equal to one horse-power working 150 days in the year. 'The object is,' he adds, 'to use this natural force, by guiding and directing it, for levelling the ruggedness of the hill.'

"The preliminary treatment of the hill above indicated is then supplemented by what we may call the 'doctoring' of the ravines and by protecting the base of the slopes. For the latter purpose a large trench is carried round the foot of the slopes. Next dams are carried across the ravines above the horizontal trenches and gradually raised as time goes on. The framework is thus arranged in a manner which gives control over the drainage. Finally, small channels are led diagonally at steep inclination from the upper horizontal trench to the ravine hollows behind each dam. When rain falls, water, laden with soil, is carried diagonally into the hollow above each dam and allowed, when clear, to issue on the other side. Here the issuing stream is joined by the diagonal earth-laden feeder from the ditch above, and the waters of the two joining together are carried into the hollow above the next lower dam. The issue is made, after deposit of silt, from the opposite side, and thus the drainage, of which the torrential force is broken, is carried in a zigzag fashion, with halts behind each dam, to the main trench at the foot of the declivity.

"If there should be uneven land more horizontal in character at the base of the slopes, it may be levelled by silt deposited by the drainage, now completely under command, on a system similar to that adopted ordinarily in the plains."

I have now spent all the time I dare in demonstrating the great and patient work which, guided by its best intellects, has been accomplished by Italy, and I think you will all agree that in that magnificent work Italy has afforded a grand object-lesson to the world. I will endeavour now to suggest, though but imperfectly, the possible application of the lesson to India.

Going back to our text: "It is a grave error not to profit by fertile silt wherever it is available." It is doubtful whether in any country the adoption of the text and its application is more needed than in India. The crying want of agricultural India is manure. Admitting that water is its first need, and this is only true of some regions, we know that everything possible is being done by the State to satisfy that need. But water alone does not suffice. It has, indeed, been proved that pure water tends to impoverish land which is not refreshed by adequate manure.

The three most valuable manures which are in the West employed for the fertilization of land are in the East either exported or burned. These are bones, oilcake, and farmyard manure. The first two are exported, the last is, except in the rainy season, dried and burned as fuel. Imported and artificial manures are too costly for the ryot. It is difficult to see what other manure supply is available to India except the fertile silt of its rivers, streams, and drainage. If so it follows as a corollary that the drainage, streams, and rivers must be so bridled and controlled as to make them yield to the land as much as is economically possible of the fertile silt which they carry.

This is just what has been done in Italy. If India could do likewise, on the same scale, what would be the result? In Italy we have an area of, very roughly, 100,000 square miles; in British India an area, very roughly again, of one million square miles. We have assumed that the bonificated area of Italy will sooner or later be 10,000 square miles, or 1-10th of the whole country; allow one-half for silt deposit, and that will mean 5,000 square miles, or 1-20th of the whole area as built up by silt (*colmata*). This is well under the mark, especially if the agriculturists have their way in the future. Applying the fraction 1-20th to India, we should have 50,000 square miles of silt deposit.

It may be said, it has been said, that India does not lend itself so well as Italy to Bonificazione. Possibly. We never know till we try. But an intelligent consideration of the maps of India might lead to the opposite conjecture. Let us examine them. They prove at any rate the value of silt deposit.

Here is the one showing "Physical configuration." You will understand it better if you are told that if the sea were to rise 1,000 feet, India would be reduced to an island about half its present size. Now look at its river system. The whole of the drainage of the Himalayas, north and south, pours its wealth into India (Tibet gets none of it) in three great systems. There is the Indus system, which derives its waters from both

northern and southern sides of the range. There is the system of the Ganges fed by a succession of rich rivers along its length, each richer than the one above. There is the Brahmaputra system, which carries the splendid soil that has formed Assam and Eastern Bengal. Simla, as befits the residence of the great Viceroy, is a corner-stone of the building. The rain that falls on the roofs of Viceregal-lodge descends on one slope to the Arabian sea; on the other to the Bay of Bengal; and in almost direct line from the Viceroy's house, on the other side of the vast mountain range, is the mutual starting point of the Indus and Brahmaputra, destined after long journeys to east and west, during which they drink in the drainage from the Northern inclines, to turn round at last, with all their riches, abruptly into India.

The remaining drainage is with minor exceptions that which flows east and west from the island you were asked to imagine, more, much more, east than west because there is a general trend to the east from the mountain wall which rises out of the western sea.

What in past ages became of the silt carried by all this drainage can be best understood by looking at the geological map. You will observe how simple is the geological surface of India. Neglecting small patches there are only three great sections, the alluvial deposit, the trap or black soil, and the Archæan rock.

You will at once see where the silt from the southern slopes of the Himalayas has gone. It has formed or at any rate overlain the great alluvial sea, if I may use the term for dry land, which sweeps round from above Bombay by Peshawar to Calcutta. Drainage from the northern slopes has made almost a Nile of the Indus, and, looking at the area it has built up, more than a Nile of the Brahmaputra. The silt of our island drainage has formed strips and deltas of pure alluvial soil on the river banks and along the sea coast.

The map, however, does not show those silt deposits which the geologists have not classed as alluvial *inside* our island, though we know that there are rich valleys of level black soil within the trap area; that there are extensive rice tracts in the south of India; that there are here and there vast pockets of rich soil.

The comparative value of the pure alluvial, let us call it silt, which surrounds the island can be partly indicated by the next map, that showing density of population. Naturally people crowd on to the best land and you will at once see how the colour darkens along the Himalayan plain; how it deepens as it approaches the delta of the Ganges; how dense are the patches which crop up along the deltas of the Eastern coast; and how everywhere the darkest colour prevails on the alluvial soil or silt. I may be challenged by the suggestion that population follows the rainfall as well as the soil. This is also true. But the dark patches in Madras, where there is less rainfall than on the slopes above, are significant of the attractive influence of alluvial soil.

Time will not permit me to take you round India, and I will confine your attention to that half of the great alluvial plain which is traversed by the Gangetic system of drainage, and is known as the Gangetic valley. Umballa, opposite our viceregal cornerstone, may be taken as the summit of the watershed between the Arabian Sea and the Bay of Bengal. The distance from Umballa to Calcutta is roughly 1,000 miles, and the fall 1,000 feet, or just one foot in the mile.

It is not difficult to understand that, gentle as is the descent, the general law of all slopes must prevail, and that the lightest and most fertilizing particles of silt are carried furthest. Hence we find sand prevailing near Umballa, loam or a mixture of sand and clay in the Upper Provinces, and clay in Bengal.

The tendency to lighter soils above and heavier soils below, is intensified by the circumstance that the monsoon rainfall increases as we proceed along the Himalayan range from opposite Umballa to opposite Calcutta. Heavier rain means more abundant forest vegetation. Consequently the silt washed down from the mountains becomes, as we follow the increasing rainfall, richer and richer in those fertilizing ingredients which go to make clay, at the same time that a more and more abundant quantity is carried down.

Thus there are four factors which have to be considered. Downflow of plains silt; rainfall; quality of mountain silt; quantity of mountain silt, all increasing as we descend from Umballa to Calcutta.

Let us now restrict our area of observation more closely and confine our attention to the upper half of the Gangetic valley, excluding the richer clays of Lower Bengal. What can be done in that region? We cannot alter the rainfall, we cannot improve the quality of mountain. But we can check the downflow of plains silt; and we can arrest some of the mountain silt. At present we allow the old silt to be stolen away, and the new silt to slip through unused.

The facts which I wish to impress upon some

minds are these, that the Himalayan drainage which must have once built up this vast Gangetic plain has now been concentrated into great rivers; that these rivers have, too frequently, cut deep channels for themselves in the plains which they created; that they have not only ceased to fertilize the land with fresh deposit but actually erode and gradually but continuously carry away the silt that they once laid down; that they are assisted in the work of destruction by the numerous feeders which each year eating through rich layers of deposit carry the most fertile elements of the old silt into the Jumna, Gogra, and the other large rivers which utilise the Ganges as a drain for hurling their stolen wealth into the sea. How I wish I could show you the hideous belts of gullies which flank so many of our rivers and their feeders, and which in the Jumna sometimes stretch inland for miles beyond its banks. You could then see for yourselves how the riches deposited by past ages are being gradually filched away.

But the cloud has a silver lining. For it is in those very regions in which good silt has been once deposited that good silt can be again laid down. And it is those very regions where State action is probably most needed.

It is interesting to notice in reviewing the replies from provinces, that almost the only tracts where the cultivators adopt the practice of holding up silt are, putting aside ricefields, broken and hilly lands, where each ryot builds up his little fields by dams and terraces that catch and hold up a few spadefuls of comparatively poor earth. But with negligible exceptions no practice of the kind is reported from the vast alluvial plains. Naturally. For there we have to arrange for the bridling and control of drainage over extensive areas or for long distances and must work with large schemes under competent experts. The ryot can do nothing alone. But, and this is the point I am aiming at, we shall be dealing not with the poor soil of hill slopes and rugged land but with the good soil of old silt and with the good soil of new silt. Surely, if it is worth while for the cultivator to arrest the poor washings of his hillside by his own petty efforts, it is worth while for the State to arrest on his behalf the rich silt on the alluvial plain. Only the other day I met the manager of some very extensive estates in Oudh, which lies in the region under discussion, who told me that during the last rainy season a small river, breaking loose, had deposited in one direction a huge area of coarse sand, and in other directions as huge an area of fine silt, so fertile that every cultivator was holding up his hand for a bit of it.

Now, we have seen how the Italians, bridling their stream, analyse every section of its water and apply to the land whatever kind of silt may be useful; coarse sand it may be to the bottom; fine silt above it; and finer silt still on the surface. Is not this the example to be followed in our great alluvial plain?

As I have said, I must not attempt to carry you further round India, where conditions vary at every stage. But the great principles of Bonificazione—the control of drainage and the capture of silt—are, *mutatis mutandis*, capable of application in every part of the country.

I will, however, take you for a brief journey to that one part of India where our splendid engineers *have* bridled the great rivers of the North to use their waters for irrigation, and, to some extent, lately, for Bonificazione. My object is to show you how small in extent is the area with which they deal compared with that of all India. The map shown indicates geographically the country traversed by canals; the diagram demonstrates the contrast between the canal-irrigated area and the cultivated area of British India 10 years ago; and here are the figures of the most recent returns, a decade later. Total culturable (not cultivated) area of British India 420 millions of acres; total area irrigated from canals, 13½ millions, Let us be liberal and allow the canal department 20 millions of acres, so as to include all their irrigable land as well as new schemes. Still, that will be less than 5 per cent of the whole. Now, the point I want to bring out is this: that in all India it is only this 5 per cent. area that is equipped with any engineers whose duties require them to examine the conditions and capabilities of the land; that elsewhere the man of the Public Works is confined to roads and communications; that unless for aligning a new road or railway he is debarred from travelling right or left of his hedges; that he has no opportunity of studying the character of the surrounding country and none of acquiring the agricultural knowledge and instincts which are developed in the man of canals in the course of his duties and without which no schemes of Bonificazione can be successfully designed. Here, indeed, we are led to the very question discussed at the Ravenna Conference, whether the example of Germany and France should not be followed in bringing agriculture and engineering into closer union

by training agricultural engineers. This is a question which is not being neglected in India, but it does not affect the present argument, which is, that as matters stand there are some 400 million acres out of a total of 420 millions in which there is no engineer of any kind outside the road and the railway; in which the character of the country has never been professionally examined; and in which the problems involved in the preservation and improvement of the soil have never been professionally studied.

There is no doubt, however, that as time goes on, and when railways and canals can spare the men, Agricultural Departments will be equipped with engineering experts, and that the capabilities of each province for Bonificazione will be satisfactorily ascertained.

One more word. The engineer will require a map showing the drainage of the country before he can suggest any scheme for Bonificazione. I will explain how such maps have been made at comparatively trifling cost. Every field on a large scale village map, already existing, is marked by the village map keeper with an arrow showing the direction in which the water flows off the field; broader arrows are then roughly drawn along the main drainage lines plainly indicated by the field arrows. The village maps placed together show the continuous drainage lines of any given tract. Reducing these by pentagraph, a map of any scale can be provided. The only expenditure is the pay of the pentagrapher.

I gave a first trial of this system some years ago when requiring a drainage map of the district of Cawnpore, an area of 2,400 square miles. I show here a section of about a fourth of it—600 square miles. You will see how it indicates in great detail where the land is water-logged, where it is being too rapidly drained and probably eroded, and so on. The system is now adopted in the canal department as providing the best basis for the alignment of canal distributaries, and would be equally useful in designing schemes for Bonificazione.

A difficulty to be faced lies in the circumstance that in the greater part of India the land is in private hands, generally in small parcels. Italy got over a similar difficulty by proclaiming a campaign against malaria, but it is possible that no such course could be taken in India. The ultimate solution of the difficulty may I hope be found in the reforms which have been begun in the education of the people, and which will, by bringing them into sympathy with agricultural improvement, secure their co-operation. Thus in some provinces the village schoolmaster passes through a course in the school of agriculture; in all provinces the rural schools teach the ryot's son all about his father's fields and what grows in them; the official staff whose duties involve field inspection—and there are about 15,000 of them—are all passed through the agricultural schools; the higher officials, are in growing percentage, selected from that staff; the scholars in many advanced schools receive an education more practical than literary, and are encouraged to adopt practical professions; the sons of the landholders are beginning to enter the agricultural colleges, and the higher castes generally are finding out that the literary professions are too full and that they too must turn to trade or to agriculture for a living. The time has passed when a Brahmin student could give the answer recorded in the books of a university 30 years ago to the question how to graduate a Danish steelyard. "I call this question a downright violation of the law of God," he replied. "Are we coolies or petty shopkeepers that we should graduate the Danish steelyard?"

I wish in conclusion to explain why I have not said anything about the effect of Bonificazione on malaria in India. Partly because I am not competent to deal with the subject, partly because I am sure that this aspect of Bonificazione will receive the fullest consideration from those who are competent. The State has never grudged a rupee for the protection of the people against devastating disease, and, if in the course of time it sees its way to improve their health by schemes of Bonificazione, is not likely to withhold money or men. Agricultural improvement took precedence of sanitation when Italy began its work and is now welcomed as the *sovrano remedio* against malaria. Perhaps history may run the same course in India.

DISCUSSION.

The CHAIRMAN:—I am sure you will all agree that the paper we have just heard has been most interesting and instructive, so instructive in fact that I wish your Chairman had more technical and expert knowledge of the subject and was able to speak about it on something like the high level attained by the author. But though I have always taken the keenest interest in canal irrigation in India, and did much while I was at the head of the Public Works Department to urge its claims and to secure a larger share of the revenue of the country to be spent on extensions of the canal system, I cannot say that my attention was ever specially drawn to the question of river silt

except in one way—it was always spoken of in the Irrigation Department as an unmitigated nuisance. Whether it was the silt that collects in the canals, especially when the water is checked and led off into side channels or distributaries, which involved a closing of the canal during the periodic and expensive cleanings, and presented constantly growing difficulty as to how to deal with the silt when cleared out, or whether it was the silt brought down by the hill streams from the outer hills of the Himalayan range, and spreading out in cone-shaped fans to the destruction of the fertile land it covered, it was generally looked on as a hostile and dangerous element. One was conscious, however, that in this mass of coarse sand and pure silica there was at times a mixture of fertile soil, for one saw in the broad dry bed of the Jumna at Delhi, or the Ganges at Cawnpore and Farukhabad and similar places, small patches which the keen eye of the agriculturist noted as suitable for cultivation, and which he turned with abundant manure into melon beds. Again, in the tank system of Madras and Mysore, where the gentle sloping valleys are crossed by numerous embankments one above the other, holding up and passing down the water from the highest to the lowest, it is well-known that the soil brought down from the sides and deposited above the embankment is extremely productive, and the crops grown in the tank bed when the water is run off are often more valuable than those in the rice fields below the embankment, into which the water is sedulously led. A similar case to this has been described by the author as coming under his observation in Gwalior. And here I may say, in passing, we have a curious instance of what is mentioned in the paper, the necessity that the engineers should also be agriculturists. The Madras engineers who have so skilfully controlled and organised the vast tank system were, and perhaps still are, strongly opposed to the cultivation of crops in the tank bed, on the ground that it tends to fill up the bed and decreases its water capacity; and in the Mysore famine of 1877 Colonel Scott-Moncrieff and I had to use strong measures to get this restriction cancelled, and the starving ryots permitted to raise crops on these areas. But the idea mentioned by the author that you can not only ascertain by chemical analysis when the flood waters of a river contain fertilising soil, but also can ascertain beforehand when they are going to contain such soil, so as to be able to turn only such water into the fields, and only during the short time for which this condition lasts, was certainly never mooted in my time, and deserves very careful consideration by our Indian engineers. I confess that it seems to me to be surrounded by much practical difficulty, for you must have the proper officer in his place at the proper time to turn on the water, and if that time only occurs six or seven times in the year, and only lasts a few hours, I fear that, being an Indian subordinate, he will often not be there in his place. Moreover, it is hard to see how it will pay to construct sluices and distributaries, and keep them in constant repair for such very occasional use; still, hard as the process is to realise, what has been accomplished in Italy ought to be practicable in India, and we ought not to be deterred by *prima facie* difficulties. Sir Edward Buck's comprehensive survey of Indian geography, together with the lantern slides, which will not, I fear, be available for the reader of the paper in the Society's *Journal*, has given a fairly clear idea of the tracts to which he would propose to apply the principle of Bonificazione by the deposit of fertilizing silt. The instances given at the beginning of the paper were all on a small scale, and the interesting method he describes of the building up of hills, and of dealing with ravine-riddled tracts, like the banks of the Jumna, seem to require minute attention to contour lines, and the laying-out of surface drains and trenches, rather than the application of river silt. But his description of the way in which the whole of the Indian plains have been created by the action of great rivers, which, to use Tennyson's words, "draw down Æonian hills, and sow the dust of continents to be," seem to show that the system should not be—like the Ganges and the Jumna, and the five rivers of the Punjab—applied to the great rivers which have cut channels so far below the surface of the land, but to the smaller streams rising and running in the plains themselves, like the Limone river in the Ravenna province, or the Isan river in the Cawnpore district. And while by the help of these rivers, the fertile soil from the head of their basins might be caught and distributed over the lower part of these basins, it would be even more worth while to pour the fertilizing silt on barren and unproductive land, such as the large tracts of "oosur" land, impregnated with saline efflorescence, at the reclamation of which Sir Edward and I worked together long ago. Then we come to the question of the cost of the operation, and I have already suggested fears on that head. In his official report, on which the paper is largely based, and which he has been good enough to lend me, Sir Edward mentions four cases of private works which he has culled from official documents in which the value of the land was greatly raised, and of which the average cost per hectare, in the four cases he has mentioned, was 567 francs, which corresponds to 230 francs per acre, or say £9 or 135 rupees per acre. Assuming that the outlay was borne by Government, as it would be in the case of canal construction, would such an expenditure be remunerative? Could the interest on the capital be recovered by enhancing the rent? We know that in the case of canals it is a rough general rule that the capital cost should not exceed Rs. 50 or Rs. 60 per acre if the canal is to be commercially successful. The meaning of that is, that the interest on Rs. 50 at 4 per cent. is Rs. 2, and the cost of upkeep, distribution, &c., is about the same figure, and that the ryot will hardly ever be willing or able to pay more than Rs. 4 an acre for the use of the water. Here, with a capital outlay, on the basis of the Italian figures, of Rs. 135, the

interest would be between Rs. 5 and Rs. 6, and there must, I presume, be some regular charge for upkeep, so that I fear we are getting into almost prohibitive figures. Perhaps, however, work of this kind can be done at a lower cost, Indian labour being cheaper than in Italy. I trust I shall not be thought to be unduly critical or pessimistic in these remarks. They are difficulties which have struck me in reading the paper, to which I have already referred, and the proof of this paper, and it is very likely that Sir Edward Buck may be able to dispose of them in his reply. And we must not forget that he mentions another kind of Bonificazione besides that of making the fields more fertile, viz., the benefits to health which will occur from raising the level of low and marshy soil so that the pools may be filled up in which mosquitos breed, and thus the main source of that terrible curse, malarial fever, may be removed. No doubt there are many parts, especially in Eastern Bengal, where great benefits would accrue from such a process; but whether it could be, as he suggests, effectually applied to the Terai seems to me doubtful. There, as you know, the trouble comes not from lodgment of surface water but from the springing up from below of the water of the streams, which get lost in the stony talus at the foot of the hills, and reappear gradually at a lower level. I can hardly see how the imposition of any layer of silt on the surface could prevent this reappearance. However this may be, I think we may heartily thank the author for the very interesting and instructive information he has bestowed upon us, and may support the suggestion he has made, as being well worthy of careful examination, and as containing possibly some seminal ideas which may be of great value to the country. But before closing I have still, in my temporary capacity as a doubter, one other reflection to make. These great agricultural improvements, of which everybody who has travelled across Lombardy, down the valley of the Po, must have at least some superficial knowledge, have been carried out by Italians for Italians, the landowners and the cultivators co-operating with the engineers and the officials, and realising that the work will do good to the country. We have heard of Count Pasolini's grandfather "the great statesman and equally great agriculturist," and we are told that private owners are so satisfied with the financial advantages of the silt system that the practice is rapidly spreading. Can we be sure of such co-operation and such enterprising landowners in India? Unfortunately we cannot. Our engineers are foreign to the country, and if even in Italy it is admitted that engineers are apt to be too professional and too little alive to agricultural wants, still more is that likely to be the case with English engineers in India. And so with the natives, even the leaders and most educated among them. We have trained them in literature, and Herbert Spencer, and so forth, and taught them to demand a larger share of political power, which they are doing, much after the fashion of suffragettes, but we have not done much to teach them the duty of landowners towards the improvement of their land, nor has agricultural engineering become a profession of dignity and profit. Sir Edward speaks hopefully of the agricultural schools and the practical training of the village schoolmaster and the village accountant, but I fear they are as yet in a very rudimentary condition; and before his idea as to reclamation and fertilization can be carried out on a large scale, through local agency and with popular support behind them, we must follow the example given by Germany and Austria, by France and Belgium, and set up a dozen Cirencester Colleges, one in each province, or even something more advanced than Cirencester, and with a larger outlook, so as to create a class which will do in India what English landlords do, as regards experiment and investigation of the qualities and possibilities of the soil. When this is achieved, there may be some hope of saving agriculture from its liability to seasonal catastrophe whenever the rainfall is untimely in its incidence or deficient in its quantity. May I, in conclusion, say a few words to express my admiration of the great part which the Italian Government has taken in this work? Sir Edward tells us that they have applied this system, or are in process of applying it, to about 10,000 square miles, have reclaimed the marshes, filled up the swamps, covered the whole with fertilizing soil, and almost extirpated the malarial mosquito, at the cost of £9,000,000. And this has been done by the poorest country in Europe, in order to improve the sanitary and economic condition of its people, in spite of very heavy taxation, and almost in silence; for in all the discussions I have seen on Italian finance, I have never heard mention of this particular class of expenditure, nor any selfish suggestion for curtailing it in order to relieve the over-burdened taxpayer. Surely no grander work of far-seeing benevolence has ever been undertaken by any country, and we may heartily support Sir Edward Buck's advice to the Indian Government to study its methods, and, as far as the system is applicable to India, to go and do likewise.

Dr. J. A. VOELCKER said that he had listened with great interest to the paper, and he also had especial pleasure in recalling the great kindness which the author showed to him personally when he was in India endeavouring to investigate some of the great agricultural problems with which Sir Edward Buck's name and work had been identified. He had very rightly referred to the great value of silt, and told them that it was a material which ought by no means to be neglected, yet to some extent this had been the case in India. His remarks with regard to the chemical or fertilizing advantages of silt were perfectly correct. The principal advantage of silt was of a chemical nature, and consisted in actual elements of fertility—nitrogen, phosphoric acid, lime, potash, &c.—being brought on to the soil. The author might also have referred to another point having special importance in connection with

India, namely, the physical advantages attending the use of silt. In a country like India, where very much depended upon the retention of moisture in the soil, it was above all things essential, as nobody knew better than the Indian cultivator, to keep a fine tilth on the surface of the ground. In this way, cultivation and drainage were improved, and the moisture was kept in the land, thereby increasing the actual fertilizing value of the silt. The advantages to be derived from the carrying of water from rivers or canals depended upon four considerations. Firstly, whether silt was being carried with the water, or not; secondly, what kind of silt it was; thirdly, what quantity; and fourthly, at what time of the year, and for how long it was carried. The whole question as to whether silt could be economically used or not resolved itself more or less into a consideration of these four points; and it seemed to him that in India there was a great deal of variation in the conditions met with. He had seen the application of silt in many parts of India, and he had also seen other parts where it had not been used and where some thought it might have been. Silt, moreover, could not be spoken of in general terms, because it depended upon what it came from. There were some kinds of rocks which produced a silt which was not worth having, while there were other kinds which produced a silt which was immensely valuable. It was necessary to discriminate in the use of the one or the other. Then, if silt was coming down for part of the year only, it was a consideration whether any work of reclaiming it could be economically carried out. It was well known that perennial canals often contained no silt at all, and to let them go over the land was simply to increase the bulk of the water and to intensify the malaria which it was so desirable to remove. On the other hand, with what were called inundation canals, where the water was taken at flood-tide, not only water but silt was placed on the land; at the same time the drainage was improved, and an excessive quantity of water, which might in the long run produce malaria, was not stored up in the soil. He had recently read a paper, written in 1897, containing an account of some work done by the Agricultural Department of the Government of India on the question of the utilisation of silt, and he could not help being struck by the enormous variations shown, both in the kind of silt and in the time during which it came down, thereby emphasising what the author had insisted upon, namely, the need for further enquiry. He thought the author would agree with him that it would only be right, before the Government undertook any big scheme, to make careful enquiries, because he was sure that the scheme put forward was no universal remedy, which could be applied anywhere and anyhow. He had also had the advantage of seeing what was being done in Italy, having travelled across the plain of Lombardy. No one could help being struck by the immense fertility of this district, but it had to be remembered that the rivers of Lombardy carried down not only an enormous quantity of silt, but silt of a most valuable kind. In the case of India, as had been pointed out, it was quite true, that some of the most valuable silt was being run down to the mouth of the river, and thence into the sea; but if it was going to be all stopped in the upper parts of the country, it would be a case of robbing Peter to pay Paul; somebody would miss it down below. In travelling over India, one could not help observing that the native had a very fair knowledge of what was good, and what was not good, and he had only utilised on his own account the silt which was really valuable. He (Dr. Voelcker) was a little afraid that, if a big scheme of the kind suggested by the author were undertaken without due enquiry, and the engineers were not sufficiently agricultural, it might result not unfrequently in the utilisation of silt regardless of its quality. He, therefore, desired to emphasise the importance of Sir Edward's suggestion of the need of enquiry, and of the different Departments paying attention to the agricultural side of the matter, a point on which the author in his own work had always so strongly insisted.

Mr. R. B. Buckley, C.S.I., M.Inst.C.E., said the author mentioned that the text of his paper was, that wherever fertilizing silt could be found it was a grave error not to carry it on to the fields. He cordially agreed. The Chairman had said that his experience of silt was that all engineers regarded it as an unmitigated nuisance. He (Mr. Buckley) was an irrigation engineer, and did not at all agree with the Chairman's statement. If amongst those present there were any other irrigation engineers who had devoted their lives, as he had done, to trying to improve agriculture in India, they must have listened with special interest to the paper. Although irrigation engineers undoubtedly found silt a nuisance at times, they were fully aware of the good results it could produce when, as Dr. Voelcker had pointed out, the right sort was obtained. He knew several tracks of country which were sandy wastes when he first became acquainted with them forty years ago; they were now, after twenty years' irrigation from the Sone Canals, in Behar, fertile plains of rice, partly because they had obtained water, and largely also because they also had obtained fertilizing silt. That land forty years ago was rented for six or eight annas a beegah; when he was there eight or ten years ago it was let at seven or eight rupees. Another instance of the fact that rent could be largely increased by the proper distribution of the proper kind of silt was to be found near Patna. There was an old depression close to Bankipur which was filled up with the water of the Ganges every year, and received a deposit of silt; and he believed the rents of some of that land were eight and ten times as large as were received from land not possessing the same advantage. The Nile conferred great benefits upon all the lands it watered. It was estimated that it carried down to the sea a volume of no less than 50 million tons of silt a year, although it

contained only about $1\frac{1}{2}$ ounces in each cubic foot of water. Fifty million tons conveyed a small idea of what it really was, but it was an enormous volume. If the whole of Hyde-park and Kensington-gardens were covered up with silt to the height of the top of the Albert-hall, something like 50 million tons would be used. In the Indus there was something like $2\frac{1}{2}$ times the amount of silt there was in the Nile, but the Nile silt was, he believed, always highly fertilizing, and the Indus silt was not equally good. The Ganges, the main source from which the author proposed to carry out the improvement of the land, contained roughly something like three times the volume of silt that the Indus did — an enormous volume. The author was undoubtedly right when he said that, if the silt from the rivers of India was placed on the land, it would confer the greatest advantages on all agriculturists; but it was necessary to think for a moment or two what he proposed to do. The lands in Upper Egypt were, and had been for thousands of years, watered from the Nile. It had been estimated, from certain facts connected with the foundations of the two Colossi which are seated on the plain of Thebes that, in the course of 2,400 years, the Nile, which nearly every year had flooded the plain, had raised it by 6 feet, which worked out at a minute fraction of an inch in a year. That was what would be obtained in India if rivers, such as the Indus, the Ganges, and the Sone, were tapped, and the water put over the land to a depth of something like three or four feet every year. He thought those who had listened to the paper had rather gathered that the lands would be raised in a marked way. That could be done on a small scale in certain places, but it could not be done on a large scale over a great area, because the silt in the water was not sufficient. The author had said that the ultimate aim he had in view was to apply the system to 50,000 square miles of country, *i.e.*, something like 30,000,000 acres. He did not think Sir Edward quite appreciated how much was now being done, and had been done for years, in the same direction in India. The last returns prepared by the Government of India showed that 20,000,000 acres of land were being irrigated by the great Indian canals. That portion of this area which was irrigated during the flood season was now being more or less subjected to the same process which the author recommended for another 30,000,000 acres. The canals of India at the present moment tapped the rivers, and deposited the silt on the land. The Sone Canals, with which he was intimately acquainted, carried every year some 2,000,000 or 3,000,000 tons of silt, and deposited it on some 400,000 acres of land. The great Chenab Canal, the glory of the engineers of the Punjab, carried every summer season something like 5,000,000 or 6,000,000 tons of silt and deposited it on the land. The great inundation canals in the south of the Punjab and in Sind, and indeed every other canal in India, except those that took their water from reservoirs, were doing more or less the same thing. That is, they were carrying the silty water of the river, and depositing the silt on the land. The Chairman had referred with some doubt to the question of cost of Sir Edward Buck's proposals, and he shared the same doubts. Nobody would deny that, if the good silt could be taken out of rivers and placed on the land, it was an excellent thing. Analyses made by the engineers of the Punjab, and by those on the Sone Canals, showed that something like two-thirds of the silt was good, the other one-third being sand, and comparatively useless. But the important question was—What would it cost? In order to carry the water from the rivers, and place it on 30,000,000 acres of land, it was necessary to make canals to carry the water. The volume to be carried would be enormous, and the canals would have to be numerous and large. But what would that cost? The author had referred to what Sir Colin Scott Moncrieff had said with regard to the improvements in the Moselle district. The improvements were undoubtedly very good, but Sir Colin gave the cost at from £17 to £28 an acre. He did not mean to say it would cost that amount to carry silt from the Ganges and the Indus on to the lands of India, but it would certainly cost a very material sum. In the "basin" lands of Upper Egypt the cost on some 2,000,000 acres was between £3 and £4 an acre. If the author intended to reclaim or improve 30,000,000 acres in that way, he would have to make canals similar in style to those which had been already made in India for irrigation purposes. To construct similar works to irrigate 30,000,000 acres would cost about £100,000,000 sterling, and about £2,000,000 a year to keep them working. He also doubted whether it would be as easy to make such works in the Valley of the Ganges as it had been in the Valley of the Nile; the circumstances were not nearly so favourable. He did not say it was not a matter for investigation as to whether the system might not be applied in certain cases with advantage, but he did say that, before £100,000,000 sterling was invested on such works, it would need far more enquiry than had at present been given to the subject. At the same time, he wished to thank Sir Edward for having brought the subject to their notice, because he was fully aware of and highly appreciated the immense benefits which occurred when silt could be brought on to the land at a reasonable cost.

Professor W. J. SIMPSON, M.D., remarked that if the author could get the Government to accept even the experimental part of his scheme he thought he would have done a very great service to India. He had no doubt whatever that, in some parts of India, it would be possible, after due enquiry, to find some places in which the system could be applied. He had interested himself a good deal in the question of inoculation in regard to man, to render him more resistant to certain diseases, and had naturally interested himself also in recent

experiments in regard to improvement of crops by inoculation of the soil with nitrogen fixing bacteria. He recently asked Professor Bottomley, of King's College, who had devoted a great deal of attention to the subject, whether it was not possible that inoculation could be applied to some of the lands of India. The practice had been carried out very largely in America by agricultural parties with great success, and recently Professor Bottomley had made a large number of experiments in regard to the poor lands of England; by utilizing bacteria which only cost sixpence a packet, or even less, he had been able to produce crops which were equal in quality to those produced from land which had been manured at a cost of £2 an acre. Not only had Professor Bottomley succeeded with leguminous plants in inducing them to fix the nitrogen of the atmosphere by these bacteria, but he had extended it to other plants. It had struck him since reading the paper that there might be a possibility of applying such a cheap process to India, because it could be easily used by the Indians themselves, if the nitrogen fixing bacteria were prepared and the packets distributed with instructions for their use. He cordially thanked the author for his interesting paper, and hoped he would be more successful than the irrigation engineers believed would be the case.

Mr. T. H. Middleton (Assistant Secretary, Board of Agriculture and Fisheries) confessed that he had come to the meeting in rather a sceptical frame of mind towards the subject of the paper, as he happened to know something of Indian conditions. He rose for the purpose of saying that, having listened to the paper and the discussion, he should go away feeling that he had got a new light on the subject which Sir Edward had placed before them. The author had, in his opinion, given them an idea which was distinctly worth following out. He remarked that the difficulties which had been referred to in connection with the agricultural engineer and the native cultivator were not serious difficulties. The agricultural knowledge which would be required by the engineer in charge of such works as the author had referred to would be very small; it would be knowledge which could be quickly acquired by anyone at all interested in the subject; and everyone who knew the Indian cultivator knew his skill in dealing with irrigation water, and the care he took in preventing erosion.

Sir Edward Buck, in reply to the remarks the Chairman and Mr. Buckley had made with regard to the cost, said he could only refer them to the observations he had made with regard to the little place near Cawnpore, outside the area being dealt with by the canal engineers, which is the only portion in something like 50,000 square miles under that kind of treatment, and the man had made it pay, having quadrupled the value of the land, though he had done that more by preventing the escape of the old silt than by obtaining new silt. He wished it to be clearly understood, however, that he had not made any proposal for action; the only thing approaching to a proposal was that the surfaces of the country should be studied by competent engineers, who should decide whether or not anything of the kind could be profitably undertaken. He had not ventured to go further than that, because he was not competent to do so. He referred his audience to the text with which he had begun, namely, that "Wherever fertilizing silt is available it is a grave economical error not to profit by it." By the word "economical" he inferred profit. If it did not pay, the work, of course, should not be undertaken, unless the malaria and unhealthiness of the country were so great that, as in Italy, the health of the people demanded that the expenditure should be made; but agriculturally nothing ought to be done unless it could be proved to pay.

On the motion of the Chairman, a hearty vote of thanks was accorded to Sir Edward Buck for his valuable paper, and the meeting terminated.

Mr. J. D. Anderson writes:—Sir Edward Buck's admirable and most interesting and suggestive paper on the "Applicability to India of the Italian Method of Utilizing Silt," deals only with those comparatively elevated portions of the Gangetic plain, where the great rivers have affluents, and do not frequently overflow their banks. The problem is a different one in Central and Eastern Bengal, where the minor rivers and channels are effluents, not affluents. In Eastern Bengal, now probably the most healthy and prosperous region in Northern India, the beneficent action of the greater streams in pouring fertilizing silt into the marshes lying behind the raised river banks, cannot be questioned. For instance, there is in this region a *pergannah*, or fiscal division, called Khaliajuri, which, a hundred years ago, was a vast sheet of water. It had practically no "assets," to use the revenue phrase of the day, at the time of the Permanent Settlement, and was permanently assessed at a merely nominal sum. Since then, the turbid and silt-laden stream known as the Kangsa has been pouring soil into its marshes through innumerable winding *khals* or channels, and it is now one of the most prosperous and thickly populated tracts in Eastern Bengal. It might indeed serve as a typical example of "unearned increment" under the Permanent Settlement. This tract is, of course, subject to deep floods during the rainy season, but the inhabitants, with the usual Indian adaptability, have suited their life and cultivation to their surroundings. The rice they grow is of the long-stemmed variety, which rises with the rising flood and loves deep water. The villages are built on artificial islands, and are surrounded by cow-sheds sloping to the water's edge. The villagers go out in their boats and cut marsh grass for their stall-fed cattle, whose rich milk furnishes the well-known "Dacca cheese," so called,

not because it is made, but because it is sold, in Dacca, the capital of the new province of Eastern Bengal.

In Central Bengal the conditions more closely resemble those of the valley of the Po and of similar tracts in Japan. The rice grown is not of the long-stemmed variety, and much of the land is given up to fine crops of jute, to which heavy floods are fatal. Consequently, many districts in Central Bengal are surrounded by expensive embankments, which are carried across the mouths of the channels which should be kept open for the natural dispersal of the fertilizing silt. The result is that the silt, instead of being spread over the fields, is deposited on the bed of the river. Consequently it becomes necessary to add continuously to the height of the embankment, until nature, in a year of high floods, takes her revenge, bursts the embankment, and destroys the standing crops. There is much loss of property and sometimes acute distress. But the cultivators are in the long run remunerated, for the fields, refreshed by the silt-laden flood, often yield bumper crops. It would seem that here engineering skill might improve on the Italian example by aiding nature to distribute the silt of the great rivers without causing the floods against which the present blind and unpierced embankments are raised.

The question is not merely one of agricultural prosperity, for these embanked districts have an ill-fame as the abode of "Nuddea fever" and "Burdwan fever," remittent agues due, no doubt, to the mosquitoes that breed in the water-logged area within the embankments. Such is the state of some of the most populous districts of Bengal, quite close to Calcutta. No doubt it would be impossible at this stage to remove the embankments. That would involve too harsh and sudden a change in the habits of the people. But perhaps it would be possible to admit the floods into the low lands behind the embankments, in such a fashion as to enable them to carry the silt without damaging life and property. The discussion on Sir Edward Buck's paper showed that in the tracts which drain into the great rivers of Northern India, questions of expense may render it impossible to apply the Italian system of irrigation. But in those deltaic tracts, which drain out of the great rivers, it might perhaps be possible to discover some middle way between shutting out the river water altogether, and the sudden and destructive floods which result from the consequent raising of the river beds. It is some years since I served in Central Bengal, and I make my suggestion with much diffidence, inasmuch as it is possible that steps have already been taken in the direction of controlling rather than excluding the silt-laden flood water. Italian and Japanese experience has shown that the bed of a river is not the proper place for rich and fertilizing silt. On the other hand, the rivers of the Gangetic delta are so swollen and strong that it will necessarily tax engineering skill to control their waters. I trust Sir Edward Buck will excuse me for adding a corollary to his extremely interesting paper. Bengal is so often regarded as the granary of Northern India that it does not occur to administrators to suggest a possible addition to its agricultural resources. As a matter of fact, however, Central Bengal is not so prosperous as is commonly supposed if the bulk of its population be considered, and the prevalence of malarious fever has for the last fifty years caused anxiety to the administration. It is just possible that Sir Edward Buck's inquiries in Italy may enable him to suggest some remedy, though, of course, the comparatively small and stagnant Italian rivers present a much easier problem to the engineer and to the riparian cultivator than the great streams of Bengal.

RAILWAYS IN THE CONGO FREE STATE.

Two important steps have recently been taken on the further development of the railway system in the Congo Free State. Two new lines have been opened that will very materially aid in giving access to that country. One runs from Stanley Falls, where the river Congo ceases to be navigable, in an easterly direction towards Mahagi on the Albert Nyanza, a distance of 695 miles, and the other starts from Stanleyville, the city by the falls, and running from north to south, partly by boats on the navigable portions of the Upper Congo, and partly by a railway for such portions of the stream as are not navigable, ultimately is bound for the district of Katanga, in the extreme southern portion of the Free State, where there are great copper and gold fields. Of this latter line the road was opened on September 1, 1906, from Stanleyville to Ponthierville, and is now in operation for a distance of 79 miles. The following, according to the American Consul at Antwerp, are the terms and conditions on which these two great projects have been undertaken. The Congo State contracted to build the road bed on account of the railway company, which agreed to supply the entire superstructure and the rolling stock free on board at Antwerp. Until the opening of the line, all the work done by the State is charged for at cost. The State further guaranteed to the company 4 per cent. interest on its capital, and is to assign to it for every £1,000,000 of capital invested 10,000,000 acres of land, which they are to dispose of jointly, dividing the profits therefrom in equal shares. When the Government first started these enterprises seven years ago, it attached greater importance to the line projected to the Albert Nyanza Lake and the Nile. It therefore pushed all the preparatory work for this section, so that the route was already surveyed to the lake by 1902. But while the railway company was forming, and these preparations were being made, the political interests of the Congo State in this line to the Nile underwent a change. At the same time the discovery of rich ores in the district of Katanga at once made the construction of the southern lines

the more urgent and the more important of the two. This new road, 79 miles in length, runs through a country covered mostly with primeval forests and intersected by numerous streams which had to be crossed by twelve bridges, partly of wood and partly of steel. Above Ponthierville to Kindu there is a stretch of navigable water in the Congo, 217 miles long, which is traversed regularly by two steamers of 30 tons each, by another vessel of 100 tons, and by a tug boat, all brought from Belgium. The trip to Kindu takes four days, and from two to three days for the return trip. The width of the stream varies, being in some places only 600 yards broad, but on the average it is 2,000 yards wide and abounds in islands. At present much work is being done to improve the channel of the river by dredging. From Kindu the navigation is being continued for the present, when the water is too low, by a small steamer up to Sendwe, 14 miles above Kindu. From this point another railway will be necessary to Buli, about 186 miles distant, to get round the next unnavigable portion of the stream, and a large number of people are now at work upon this. It is expected that the number will, in a short time, amount to 5,000. Above Buli another navigable part of the Congo will be found, about 372 miles long, up to the northern portion of the district of Katanga, and this section is now being surveyed to complete this new and great system of railway and river transportation through the heart of Africa. Thus another link has been added to this wonderful line, the construction of which was pronounced to be impossible, because of the supposed insurmountable difficulties presented to engineering skill. Only a few years ago, in 1898, the first part of it was opened, the well-known Cataract Line around the falls of the lower Congo. It takes twenty-one days for a voyage from Antwerp to the landing place, Matadi, on the Congo, and from twenty-two to twenty-five days for the inland trip by rail and by river to Stanleyville and Ponthierville, so that these places can be reached in forty-five to fifty days from Europe. A ton of goods can now be carried from Antwerp to Stanleyville at a cost of about £10.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in February and March:—

February.—New Charts.—1899—Asia Minor:—Kalimno, Kappari, and Kos channels. 2579—West Indies:—Cuba. 3630—Plans in the neighbourhood of Magellan strait:—Fitzroy channel, port Bobillier; Guzman inlet. 3612—China, east coast:—Port Shelter and Rocky harbour. 3621—Plans in the islands south of Kiusiu:—Isso; Miyanoura. 3614—Japan:—Nanao wan. 3628—Japan, Kiusiu, East coast:—Ariake wan. 3622—Australia, east coast:—Port Jackson to cape Byron. 2873—Anchorages in the Solomon islands:—Beaufort bay; Sutulahia anchorage; Vura anchorage; Auki island harbour; Sandfly passage; Albatross bay; Lengo to Teterre; Ngora fu harbour. New Plans and Plans added.—1582—Harbours on the east coast of the Adriatic. Plan added:—Narenta river entrance and anchorage.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.

No. 2154—England, south coast:—Newhaven. 2050—England, south coast:—approaches to Spithead. 2255—England, south coast:—Weymouth and Portland. 30—England, south coast:—Plymouth sound and the Hamoaze. 32—England, south coast:—Falmouth harbour. 2879—Wales, west coast:—Milford haven. 1951—England, west coast:—Liverpool bay. 2131—Scotland, west coast:—Arran island to Gare loch. 1828—England, east coast:—The Downs. 1607—England, east coast:—North Foreland to the Nore. 2151—England, east coast:—Broadness to Mucking light. 1834—England, east coast:—Bishops ness to Rochester. 1491—England, east coast:—Harwich harbour. 109—England, east coast:—entrance to the river Humber. 3497—England, east coast:—Hull road. 2567—England, east coast:—Tees bay. 1934—England, east coast:—River Tyne entrance. 1777—Ireland, south coast:—Queenstown and Port of Cork. 60—Channel islands:—Alderney and the Casquets. 2626—Channel islands:—Guernsey, Herm, and Serk. 62b—Channel islands:—Island of Jersey. 2289—Norway:—The Skagerrak. 3415—Baltic sea:—Approaches to Räfsö and Biörneborg. 144—Spain, south coast:—Gibraltar. 194—Malta and Gozo islands. 867—Bermuda:—From the Narrows to Hamilton. 1127—River St. Lawrence:—Montreal harbour. 337—North American lakes:—Toronto harbour. 324—North American lakes:—River St. Mary from East Neebish to point Iroquois. 1638—Gulf of Mexico:—Breton sound to Dernière island. 1499—Alaska:—Cross sound to Kadiak Island. 616—Africa, west coast:—Sierra Leone river. 1920—Africa, south coast:—Table bay. 1849—Africa, south coast:—Simons bay. 2404—Singapore main strait from Tree island to Batam bay. 1466—China, east coast:—Fotaumun pass. 3480—China, north coast:—Shantung promontory to Nagasaki.

March.—New Charts.—121—Sweden, west coast:—Torbiornskier to Väderöbod. 3633—Alaska:—Dixon harbour. 3620—China, south coast:—Canton harbour. 3617—Japan:—Yume zaki to Modoro zaki 3623—Australia, east coast:—Cape Byron to Lady Elliot island. New Plans and Plans added.—108—England, east coast, Skegness to Blakeney; New plan:—King's Lynn docks. 1858—Central America, plans in Yucatan; Plan added:—Port Morelos. 1304—Plans on the coast of Chile; New plan:—Comau or Leptepu inlet. 2395—Ports in the Philippine islands; Plan added:—Paskao anchorage. 1579—New Hebrides, Malekula island, southern portion; Plan added:—Pangkumu bay.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.

No. 1547 — Ireland, west coast: — River Shannon, sheet II. 1548—Ireland, west coast: — River Shannon, sheet III. 1541—Ireland, west coast: — River Shannon, Sheet IV. 1549 —Ireland, west coast: — River Shannon, sheet V. 2552—Ireland, south coast:—Dunmanus bay. 1875—Germany: —Elbe, Weser, and Jade rivers. 2302—Baltic sea: — Gulf of Bothnia, sheet VII. 3300—Baltic sea; gulf of Riga:—Windau. 798—France, west coast: — Douarnenez bay and approach. 419—Adriatic:—Anchorages and channels in the gulf of Cattaro. 2843*a*—United States, east coast:—Chesapeake bay, sheet I. 2818—United States, east coast:—Hampton roads and Elizabeth river. 2866—United States, east coast:—Winyah bay and Georgetown harbour. 1217—Gulf of Mexico: —Florida strait, south part. 486—Gulf of Mexico:—Jamaica and the Pedro bank, &c. 1266—Islands and banks between San Salvador and San Domingo. 456—Jamaica:—Port Royal and Kingston harbours. 2600—Leeward islands:—San Domingo to Dominica. 525—Gulf of Mexico:—Boca Grande cay to Tortugas cays. 1329—South America, east coast:—Bahia Blanca to Union bay. 587—Central America:—Burica point to Mangrove bluff. 629—Africa, west coast:—Walfisch bay. 2089—Africa, east coast:—Tugela river to Delagoa bay. 1235—Persian Gulf:—Mouth of the Euphrates. 1884—Bay of Bengal:—Arakan river, Akyab. 794—Malaca strait: —Pulo Berhala to cape Rachado. 2109 — Borneo, sheet VI.:—Barram point to Nosong point. 900—Celebes: —Tilamuta harbour to Tanjong Tuladenggi. 1740—China: — Canton river, sheet III. 1262—China, south coast;—Hong Kong to gulf of Liau tung. 1760—China, east coast:—The Brothers to Ockseu islands. 1761—China, East coast:—Ockseu islands to Tung Yung, &c. 2347—Japan:—Nipon, Kiusiu, and Shikoku, and part of the Korea. 1030—Australia, east coast:—Great Sandy strait, southern portion. 1031—Australia, east coast:—Great Sandy strait, northern portion. 179—New Hebrides:—Espiritu Santo island.

These charts are issued by Mr. J. D. Potter, 145, Minories.

GERMANY'S MARITIME INTERESTS.

According to recent reports of the American Consuls in Germany a publication has recently been issued by the German Government on the development of the German maritime interests in the last decade. It was probably intended to assist the Bill before the Reichstag for the further increase of the Imperial navy. Facts and figures are given to exhibit the enormous increase in the maritime interests of Germany during the last ten years, an increase which is represented by the German Admiralty as eminently satisfactory in itself, and yet not without anxiety for the future. The report shows that the comparison instituted between Germany and foreign countries makes it clear that Germany in many directions has a marked superiority over other countries, and that this advantage will in certain directions be long maintained. On the other hand there is a growing competition with German trade in foreign countries and foreign markets, which must require from Germany the most energetic efforts for the maintenance of its national welfare since any relaxation of such effort must involve the country in the danger of falling behind, and of being dislodged from the position of advantage which it has acquired at such great cost. It is indispensable to the continued prosperity of the empire to maintain and increase the economic relations with foreign countries, especially those across the sea. Since the foundation of the empire its population has increased by nearly 20,000,000 - from a little less than 41,000,000 to a little over 60,000,000. Its rate of increase is now greater than that of any of the larger European States, being over 800,000 annually, and surpassed only by the rate of increase of the population of the United States. Formerly the volume of emigration exceeded that of immigration, but since 1895 this has no longer been the case. Not only has emigration been reduced, but from 1895 to 1905 the surplus incoming population has amounted to 94,000. Between 1894 and 1904 the total German foreign trade increased 66 per cent. in value; trade with the United States increased 59 per cent., with England 38 per cent., with France 28 per cent., and with Russia 23 per cent. The rise in the value of the sea-borne commerce amounted to 75 per cent. In the report it is stated that since 1894 up to 1904, trade with the United States rose from 804,000,000 marks (£40,200,000) to 1,438,800,000 marks (£71,940,000), an increase of some 78 per cent., the increase of the "special trade" (imports for home consumption and exports of domestic produce and manufactures) with the United States being given as 59 per cent. There can be no denying the prodigious growth of German maritime interests in recent years, as an analysis of the figures amply justifies the contention of the German Admiralty to the following effect:—"Every branch of the national industry is deeply interested in the further development of the maritime trade. There is no great German industry that is not dependent upon it in a greater or less degree—in the import of its raw materials, or for the export of its manufactured products, or for both —and thus, that anything which tended to injure or imperil this indispensable factor of the national industry would certainly make itself felt more and more severely, alike as regards the supply for immediate consumption, and as regards the maintenance of employment in individual trades, thereby inflicting a loss in both directions upon the working classes of the empire."

HOME INDUSTRIES.

Coal Mining and Labour Hours.—The final report of the Miners' Eight Hours Day Committee was issued last week. The Committee has not been able to accept the general contention of the coal-owners that a legal eight hours day would mean a serious diminution in the output of coal—nearly twenty-six million tons calculated on that of 1906. But they admit that some diminution of production would follow the statutory reduction of hours, whether introduced gradually or suddenly. Their language is very cautious. In their opinion "the permanent result of a legally restricted day for workers in coal mines, upon wages and employment, is impossible to foretell, but it may be assumed that both will greatly depend upon the disposition of employers and workmen to co-operate to minimise any inconvenience that may arise in the initiation of a new system to the general public, and especially to the manufacturers of heavy goods for export." It is sometimes forgotten that the present practice varies widely, and that if the average be taken the hours are not much in excess of an eight hours day. The average time from bank to bank in all the coal mines of Great Britain is nine hours and three minutes, but the actual hours worked vary from 6 hours 49 minutes in Durham to 9 hours 57 minutes in Monmouthshire for all classes of underground workers. Allowing for customary weekly or fortnightly total stop days the average theoretical week's work all over the country is 49 hours 53 minutes. The Committee find that the reduction of time to a legal eight hours day would make a difference, counting stops and short days running as they are, of 10·27 per cent. The contention of many masters examined by the Committee was that this loss of time ought to be taken as the basis of calculation, and if it be this shrinkage of 26,000,000 tons in the output is arrived at. The Committee do not adopt this view. They find that the actual average of working hours is 13·36 per cent. less than the theoretical, or 43 hours 13 minutes, which gives an average of a little over seven hours for six days in the week. And in the opinion of the Committee, who, however, speak with hesitation, a certain portion of the time now lost would be utilised under a legally restricted day. They consider, too, that other causes would be more or less operative in mitigating the effects of a reduction of the hours of the full working day, among them increased efficiency of labour, improvements in the mechanical equipment of collieries, an extension of the use of labour-saving machinery, and of the multiple shift system, and some increase in the existing flow of outside labour to the collieries. But the Committee agree that some diminution of production would follow a statutory reduction of hours, and that any advance in the price of British coal which did not equally apply to foreign coal would injuriously affect our exports to the nearer ports, a branch of the export trade which amounts to about 14,000,000 tons. Realising the grave possibilities involved in the eight hours day, and the great national importance of the coal trade, the Committee point out that if an eight hours' day is enacted by Parliament it will be desirable to reserve in the hands of the department of the Government controlling mines certain powers of suspension and exemption in the public interest.

The Iron Trade.—The expectation that the early months of the present year would see a large decline in the activity of the iron trade has not been borne out by the event. It was assumed that the demand from America and Germany would be much smaller, whereas it shows a marked increase in both cases. In the four months ended April the shipments to Germany direct amounted to 97,643 tons of pig iron as compared with 52,302 tons in the corresponding four months of 1906, and with 38,423 tons in the corresponding four months of 1905. Some, too, went to Germany through Holland, whose imports were 67,226 tons, as against 59,473 tons in the same four months of last year, and through Belgium, which took 46,820 tons as against 36,127 tons last year. Again, our shipments to America have in the four months of this year exceeded by 161,000 tons the exports in the corresponding period of last year, and this increase follows upon one of 136,300 tons in 1906, as compared with 1905. The Board of Trade returns show that we shipped altogether 670,340 tons of pig iron in the four months ended April 30th last, as against 400,041 tons and 266,648 tons in the corresponding months of 1906 and 1905. Nor is there any reason to suppose that there has been any diminution in the home consumption. Makers have not been able to meet all the demands as required, and the stock of No. 3 Cleveland iron in warrant stores has been reduced to 348,000 tons, a reduction of some 50 per cent. from the highest. Cleveland warrants which in December last fell back to 53s. 6d., have almost recovered all they lost in the depression of a few months ago, the present quotation being 63s. Nor is the revived demand confined to foundry iron. West coast Hematite warrants have been up to 82s. and it is exceedingly scarce. There is a keen demand for it for export and the home demand is larger than ever. There are less than 37,000 tons of it in the public stores of the country and it looks as if it will soon be exhausted. The public stock of raw iron in the United Kingdom is only about 403,000 tons of all sorts, and makers hold little or none. It is said that the orders already booked for America and Germany will run over the summer months, and steel makers in the north have had to pay 85s. per ton for hematite delivered to their works. The immediate future depends largely on America, but there is no signs as yet of declining demand in the United States for either iron or steel. It is long since the iron trade looked stronger.

The Tobacco Trade.—The present position of the tobacco trade is both anomalous and interesting. The consumption of tobacco steadily grows—the

world's consumption has increased by something like 25 per cent. in the last ten years—but the acreage under tobacco has fallen from 1,030,000 in 1902 to 776,000 in 1906, and it is said that 40,000 acres have been abandoned this year. It is with tobacco in an even greater degree than with cotton that dependence upon a single country for supplies causes trouble. The cotton manufacturer, though perilously dependent upon the United States for his supplies, does get supplies from elsewhere—from Egypt, India, &c. But the tobacco manufacturer depends almost entirely upon America. And yet with tobacco as with cotton, many lands are suitable for its growth. British Africa, Ceylon, the West Indies, parts of Australia, all have climatic conditions suitable for growing tobacco, and samples are equal to the American article. The consumption is increasing rapidly. The total home consumption in 1906 amounted to 93,494,000 lbs. as compared with 88,693,000 lbs. in 1905 and 85,502,000 lbs. in 1904, whilst for the first three months of the present year it was 24,034,000 lbs. as against 23,299,000 lbs. in 1906. Naturally with the increased demand and decreased supply there is augmentation in the price of the raw material. It is noteworthy that the 821,823,000 lbs. crop of 1902 was valued at very little more than last year's crop of 629,000,000 lbs. The position is complicated by the growth of Growers' Associations, which aim at controlling the production, and threaten to dominate the markets. The Associations are at open war with the Trusts, and are said to terrorize the farmers. British manufacturers are turning their attention to the possibility of establishing other means of supply, but it must be many years before the commanding position of the American cultivator is seriously menaced. As it is, the manufacturer here finds himself in a very embarrassing position. He hoped for relief by a reduction of the duty on tobacco, or an increase in the moisture limit, but the Chancellor of the Exchequer has proposed no change. The retailer is threatening to raise the price of cigars, and it would seem reasonable to raise retail prices of tobacco, so as to make the consumer pay for the increased cost of the raw material, but in practice it is found difficult to alter what may be called the standard price of 3d. per ounce. The present position of our tobacco trade emphasises the unwisdom of being content to draw the bulk of the raw material from a single and a foreign country. The arguments that apply to cotton in this connection apply, as has been said above, with equal force to tobacco. All the tobacco, as all the cotton, required by British manufacturers can be grown within the limits of the British Empire, but even now the practical steps taken to bring about the desired change are halting and very inadequate.

The Motor-Car Industry.—The only thing the motor-car industry is suffering from at the present time is lack of capital. If capital went into the trade more freely its expansion would become more rapid than it is. But it is very remarkable. Fifteen years ago the foreigner had the market pretty well to himself. The imported motor-car was everywhere—everywhere, that is to say, where the motor-car was to be seen, which was not in very many places; the home-made car was a rarity. The foreigner has still his grip upon the trade, but it is slackening. With each year the demand increases, and the British manufacturer is improving his position as compared with that of his foreign competitor. Last year the British market was worth nearly twelve millions sterling. Of this the foreign manufacturer got nearly four and a half millions, and the British manufacturer about the same, the remainder going to those who buy foreign parts and assemble them. Altogether British trade is estimated to have benefited to the extent of about seven millions sterling. In 1903 the imports of finished cars were roughly of the value of one and three-quarter million sterling; in 1906 they had increased to two and three-quarter million, but in 1906 the growth was only about £200,000, and in the first four months of the present year they show an actual decrease of some £30,000. It is in the "parts of cars" that the foreigner still does a very large business. In the first four months of 1905 he exported to this country motor-cars to the value of £809,659, and parts of cars to the value of £237,735. In 1907 these figures were respectively £812,522 and £879,743. The import of motor-cars was practically stationary; the import of "parts of cars" had nearly quadrupled. The British manufacturer is taking in the year considerably over two millions sterling of foreign-made parts, so that a "British" car has still about 30 per cent. of foreign matter in it, by which it is not, of course, meant that there are no wholly British cars. On the other hand the British export trade is in a very healthy condition. Half-a-dozen years ago the number of British cars outside the United Kingdom was almost a negligible quantity. The foreign make was preferred abroad as here. That remains true, but much less universally true. The exports of British motors in the first four months of 1905 were of a value of only £77,138, and of parts of cars £31,312. In the same months of the present year the figures were respectively £248,705, and £159,380, which indicates substantial expansion. It is to be hoped and expected that as time goes on the British manufacturer will rely less and less upon foreign-made parts. The home factories are working at their utmost capacity. It is expected that there will be 20,000 cars of all grades made in the United Kingdom in 1907. Many more would be made if there were the appliances to make them. There is every indication that the demand will go on increasing, and that the industry will grow to great, even enormous proportions. The shyness of the capitalist is not likely to be long maintained. The distrust born of the memory of the losses of a dozen years ago must give way to the accumulating evidence of the immense possibilities of the motor-car industry. It is indeed a strange anomaly that whilst the public

responds more or less heartily to the invitation of company promoters to put money into gold mines in Siberia and cobalt in Ontario, a young, growing, and promising home industry remains hampered from lack of capital. But it is satisfactory to know that, as shown by the figures quoted, British motor car manufacturers are making their way to the front notwithstanding capital difficulties.

OBITUARY.

W. Martin Wood.—Mr. W. Martin Wood, a well-known Anglo-Indian publicist, died suddenly from heart failure at Weybridge on the 25th inst. in his seventy-ninth year. He joined the Society in 1881 and since 1890 had been an active member of the Committee of the Indian Section, and a constant attendant at the Society's meetings. He resided for many years in Bombay, where he occupied a prominent position as a journalist, first as Editor of the *Times of India*, then as part proprietor of that journal in association with the late General Nassau Lees and the late Mr. Mathias Mull, and subsequently as Editor of a weekly paper, the *Bombay Review*, which he founded. He was a Fellow of the University of Bombay and for some years one of its examiners. He was the author of a work entitled "Things of India Made Plain" and of several political pamphlets. He leaves a widow and three children, a daughter and two sons. One of the latter is a member of the Indian Civil Service.

MEETINGS FOR THE ENSUING WEEK.

Monday, June 3...East India Association, Caxton-hall, Westminster, S.W., 4½ p.m. Mr. R. F. Chisholm, "Indian Pottery."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Cecil A. St. George Moore, "Working Experiences with large Gas Engines."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Mr. W. A. Davis, "The Nature of, and Changes involved in the Production and Setting of Plaster of Paris." 2. Messrs. W. A. Davis and C. A. Klein, "The Analysis of White Lead." 3. Mr. W. Hansen Rawles, "A Calorimeter for Volatile Liquid Fuels. Specially adapted for Petrol." 4. Messrs. W. P. Dreaper and A. Wilson, "Influence of Temperature of Dyeing on Resolution." 5. Mr. J. K. H. Inglis, "The Loss of Nitre in the Chamber Process. Part III."

Actuaries, Staples-inn-hall, Holborn, W.C., 5 p.m. Annual General Meeting.

Tuesday, June 4...Asiatic, 22, Albemarle-street, W., 4 p.m. Mr. J. F. Fleet, "The Inscription on the Sohgaura Plate."

Royal Institution, Albemarle-street, W., 3 p.m. Professor G. E. Nuttall, "Malaria, Sleeping Sickness, Tick Fever, and Allied Diseases." (Lecture II.)

Alpine Club, 23, Savile-row, W., 8½ p.m.

Anthropological, 3, Hanover-square, W., 8½ p.m.

Wednesday, June 5. Geological, Burlington-house, W., 8 p.m. 1. Mr. S. S. Buckman, "Brachiopod Morphology: *Cincta*, *Eudesia*, and the Development of Ribs." 2. Mr. Herbert Bolton, "A Marine Fauna in the Basement-Beds of the Bristol Coalfield."

Royal Archæological Institution, 20, Hanover-square, W., 4 p.m. Mr. Francis Bond, "The Strange History of the English Parish Church."

Obstetrical, 20, Hanover-square, W., 8 p.m.

Thursday, June 6 Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Prof. A. Dendy and Mr. E. Hindle, "Contributions to our Knowledge of the New Zealand Holothurians." 2. Prof. W. A. Haswell, "Observations on Australasian Polyclads." 3. Mr. C. Tate Regan, "Report on the Marine Fishes collected by Mr. J. Stanley Gardiner in the Indian Ocean." 4. Mr. M. Foslie, "The Lithothamnia of the *Sealark* Expedition." 5. Prof. L. G. Neumann, "Notes sur les Ixodidæ recueillis dans les iles de l'Océan Indien, par Mr. J. Stanley Gardiner." 6. Mr. G. Claridge Druce, *Orobanche Ritro*, and some new varieties of Plants from the Channel Islands."

Chemical, Burlington-house, W., 8½ p.m. Papers by: 1 Messrs. F. Baker and E. C. C. Baly. 2. Mr. F. Tuttin. 3. Messrs. E. P. Perman and J. H. Davies. 4. Mr. I. Smedley. 5. Mr. J. C. Cain. 6. Messrs. S. Smiles and T. P. Hilditch. 7. Messrs. S. Smiles and A. W. Bain. 8. Mr. M. A. Whiteley. 9. Messrs. J. T. Hewitt and N. Walker.

Royal Institution, Albemarle-street, W., 3 p.m. Prof. Sir James Dewar, "Chemical Progress—Work of Berthelot, Mendeleeff, and Moissan." (Lecture III.)

Book-keepers', Cannon-street Hotel, E.C., 7 p.m. Mr. M. Cutter, "Wasting Assets."

African, Criterion Restaurant, Piccadilly, W., 8 p.m. Address by Mr. Shelford.

Friday, June 7...Royal Institution, Albemarle-street, W., 9 p.m. Prof. Sir James Dewar, "Studies in High Vacua and Helium at Low Temperatures."

Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Painting on Pottery."

Geologists' Association, University College, W.C., 8 p.m. Mr. George W. Young, "The Chalk of Surrey—Part II, the Western Area."

Philological, University College, W.C., 8 p.m.

Saturday, June 8...Royal Institution, Albemarle-street, W., 3 p.m. Sir William White, "The Contest between Guns and Armour." (Lecture II.)

Erratum.—By an unfortunate error the name of Mr. Wedgwood was given as presiding at the last reported meeting of the Applied Art Section (*Journal*, May 24, p. 718) instead of that of Mr. Halsey Ricardo who actually took the chair. The page containing the mistake has been reprinted and will be forwarded to any member on application.

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FRIDAY, JUNE 7, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

APPLIED ART SECTION.

Tuesday evening, May 28, 8 p.m.; SIR JOHN EDWARD BINGHAM, Bart., in the chair. The paper read was "Sheffield Plate and Electro Plate," by SHERARD COWPER-COLES, M.Inst.E.E.

The paper and report of the discussion will be printed in a future number of the *Journal.*

INDIAN SECTION.

Thursday Afternoon, May 30, 4.30 p.m; CHARLES EDWARD HOBHOUSE, M.P., Under-Secretary of State for India, in the chair. The paper read was "Irrigation Colonies in India," by LAURENCE ROBERTSON, I.C.S.

The paper and report of the discussion will be printed in a future number of the *Journal.*

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club-house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

A programme of the arrangements for the evening will be published in due course.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, April 30th, 8 p.m.; J. C. WEDGWOOD, M.P., in the chair.

The paper read was—

LUSTRE POTTERY.

By WILLIAM BURTON, F.C.S.

It would be unbecoming in me to commence a paper on Lustre Pottery before the Applied Art Section of the Society of Arts without recalling that it was from this platform, some fourteen or fifteen years ago, that Mr. Wm. De Morgan, our English pioneer in the methods of true lustre decoration, first explained his processes and their results. My reason for reading a fresh paper now, on the same subject, is that during the last fifteen years a great deal has been learnt about the history of the various lustre processes, and great advances have been made by Hungarian, French and English potters in extending and perfecting the various methods of lustre decoration. While gladly acknowledging what the English pottery trade owes to Mr. De Morgan in the way of incentive and experiment, I trust it may be found, when my paper is concluded, that English potters are now prepared to repay the debt by fresh and original work of their own. In considering the subject of "Lustre Pottery" it is necessary to spend some time in a careful consideration of what we mean by the term; for it has been applied indifferently to methods that are old and new, to decorative results that are exceedingly delicate and subtle, as well as to those that are the reverse. On the table before us is assembled nearly every variety of pottery that the most catholic of collectors could bring together under this designation. Here will be found the so-called "copper" and "silver" lustred earthenwares of Staffordshire, Swansea, Leeds and Sunderland, first produced during the latter part of the eighteenth century, so largely manufactured during the first half of the nineteenth century, and now become the spoil of those collectors who despair of attaining to the finest things. Here, too, are the oldest lustres of all, dating back for more than a thousand years when Egyptian, Syrian, or Persian potters discovered a unique method of pottery decoration which was carried round all the countries bordering on the Mediterranean, to which its apogee in the Hispano-Moresque wares of the fifteenth century and the Italian majolica of the sixteenth century. Here, too, are examples of the modern pieces made in imitation of, or in rivalry with these mediæval masterpieces; by Ginori and Cantegalli of Florence; by the Massiers in Cannes; by the Spanish potters of Seville and Manises; by Zsolnay of Pècs in Hungary; by Hermann Kähler in Denmark, and by De Morgan, Pilkington's, Bernard Moore, Maw's and others in England. Here, also, will be found the faint, nacreous, Bismuth lustres, invented by Brianchon of Paris, in 1856, but best known among us, from their use on the once famous Belleek porcelain of Ireland.

What pictures the imagination conjures up under the stimulus of such a string of names. To glance from Old Cairo and Rhages or the Moorish kingdom of Granada, Diruta in its prime and the Gubbio of Maestro Giorgio, to the days of Wedgwood in England, and on to our own times, is enough to take one's breath away. But the art of the potter has always been most conservative of its past, and in such an art, it need occasion no surprise to find the latest and youngest experimenters among us eager to emulate the successes achieved centuries ago by men whose very names are forgotten; but whose works survive "Like good deeds in a naughty world."

Even a cursory glance at such a collection, the like of which has probably never been gathered together on a lecture-table before, shows that the one feature which all the "Lustres" have in common is a shining metallic quality of surface, which marks them off from every other kind of pottery decoration. Though this quality is more or less manifest in all the decorations of this class produced during the last thousand years, let us study it first in the so-called copper and silver lustres of our every-day English pottery, introduced a little more than a century ago. Here, at all events, the metallic quality is developed to the utmost, for pottery covered all over with such lustres as these, recalls at once the characteristic appearance of vessels shaped in metal, and there can be no doubt that the Staffordshire and other English potters of the late eighteenth and early nineteenth century, thought they had discovered a delightfully simple method of making their pottery look like metal; for they shaped their vessels in exact imitation of those of the silversmiths and goldsmiths of the period; and as

they were mechanically-minded people they modelled their mugs, jugs, sugar-boxes, teapots, and candle-sticks as accurately as possible on the popular Sheffield plate of the day. All unconsciously, they seem to have been following the example of the first inventors of the lustre decoration, for there is no doubt, in my mind, that the potters of Egypt, Syria, and Persia, who made the first "lustres," in those far-off centuries when the East was still the cradle of the arts and sciences, also hailed their invention as a brilliant discovery that enabled them to make pottery look like gold.* We are so accustomed in these days to see, on every hand, pottery decorated with gold fired to the glaze that it is difficult to realise what a modern invention the gilding of pottery and porcelain really is. Gold fired on to the surface of glazed pottery appears to have been unknown to all the great potters of the Middle Ages. I am inclined to the opinion that the Chinese and Japanese may have taught its use to Europeans, and there is ample evidence that its use in Europe is scarcely earlier than the middle of the eighteenth century.† Where leaf gold had been applied to the surface of tiles or vases before this period, it appears to have been merely attached by japanners' size, and must, therefore, be regarded as an exotic decoration, for we must refuse to consider anything pottery decoration which has not been fired.

It is all very well to grind up leaf gold with a small quantity of a soft flux, which would fix it to glazed pottery on refiring at a low temperature, but the latter part of the eighteenth century, which witnessed such an outburst of experimental work in pottery, was also the period of the fresh departure in natural science which laid the foundation of modern chemistry. Gold was being experimented with in many ways, for the old search for the philosopher's stone had only taken a fresh direction, and before the end of the century it was found that gold could be applied to pottery by mixing a solution of the metal in *Aqua Regia*, with thick oily or resinous fluids, so that when a coat of the mixture was carefully laid over the pottery and fired at a low heat a shining golden deposit was immediately produced without any further trouble. So far as we can learn, it was some unknown experimenter in the Staffordshire potteries who first made this discovery, and during the last decade of the eighteenth century the method was in extensive use in England.*

It is interesting to recall, too, how soon the newly-discovered metal platinum was brought into use for the same purpose. Just as it was found that gold-chloride solution diffused in a thick oily menstruum would furnish a coat of shining gold, one of the first industrial uses of platinum was its application, in a similar way, to produce a shining deposit of platinum on crockery, which went by the common name of silver lustre, because of its resemblance to that metal in appearance and because the name "platinum" would have meant nothing to the ordinary person at that period. I always like to imagine, myself, that the introduction of these shining metallic deposits of gold and platinum owed much to our greatest English potter, Josiah Wedgwood, for from his intimate connection with the best scientific men of his day he is likely to have learnt about such a substance as platinum before any other Staffordshire potter, and Professor Church has informed us that he obtained some information on the subject of

* Mr. Henry Wallis has suggested that, as it was considered derogatory in Byzantium, during her prosperous days, to eat or drink from vessels of other metals than gold or silver, in her declining years, when the precious metals had been gradually absorbed, the potters would copy designs from the gold or silver smith, and the lustred ware became a cheap but showy substitute for the precious vessels which had previously enriched the Credenza.

In Spain, too, the old lustred ware is known as "Dorada," *i.e.*, "Gilded," and Ibn-Batuta, the famous Arab geographer and traveller, writing in 1350, speaks of the ware made at Malaga as the "Gilt pottery or porcelain which is exported to the most distant countries."

† When the King of France, Louis XV., became financially interested in the porcelain factory at Vincennes, shortly before its removal to Sèvres, it is recorded that a large sum of money was paid to a Benedictine friar, named Hippolite, for the secret of gilding decoration; and yet Vincennes appears to have been the first European factory that used gold at all extensively in the decoration of porcelain, and it was at that time not used on pottery or faience at all. The famous Wedgwood appears to have had great difficulty in acquiring a knowledge of how to apply fired gold to pottery, and almost his only patent has reference to an imperfect method of gilding.

* Simeon Shaw, in his "History of the Staffordshire Potteries," published in 1828, ascribes the invention to John Hancock, though he also mentions a decorator named Hennys as having been concerned in its introduction. But Shaw was a most uncritical and unreliable purveyor of gossip; he frequently published contradictory statements, and personally I attach very little importance to his statement. It is a matter of painful interest to an English potter to realise that this process invented in England led directly to the production of liquid gold, which is now sold by German firms to the Staffordshire potters to the amount of probably £100,000 per annum. On a small scale it is the story of the analine industry over again: The Englishman acting as inventor, and then from want of sufficient scientific knowledge, losing the trade to the better trained German.

lustre from Dr. John Fothergill, as early as the year 1776. Certainly, too, Wedgwood was one of the potters who made extensive use of these gold and platinum lustres, though other Staffordshire potters were active in the same field in the late years of the eighteenth century, and the method seems to have been pretty widely spread, as it was soon practised at Swansea, Leeds and Sunderland.

There are many examples exhibited here to-night which enable us to realise what these English lustres were like. The deposit of metallic platinum is always dense and metallic, so that vessels coated with it shine almost like silver, hence the unfortunate name of "Silver" lustre that has been generally given to it. The gold lustre is sometimes quite as dense, though we often meet with it used so thinly that the colour of the pottery on which it has been applied is an important factor in determining the colour effect. On white or cream colour ware if the lustre is thinly applied it gives only a pale purplish stain, with a faint golden sheen, but on red pottery or where it is thickly applied it may look like gold, copper or bronze. Sometimes copper was added to the gold to produce a darker and more bronze-like effect.

If we were to consider the production of a metallic surface on pottery as the true aim of lustre, then this English pottery of the late eighteenth and early nineteenth century must be regarded as the most perfect "lustre" pottery ever made, for nothing could exceed the evenness and regularity of its shining metallic surfaces.

The metallic quality of surface is, however, only one feature of the finest lustre effects, and neither the most important nor the most beautiful one. If we examine examples of the fine lustres of the Persian, Spanish or Italian potters, we shall find that the decoration, however strong and metallic it may be in certain lights, is softened and beautified by a wonderful play of iridescent colour, so that it assumes something of the changing quality of the inside of a pearl shell, or is diversified by a play of brilliant colour like a soap-bubble, or the feathers of a peacock's tail. But in these qualities the metallic films of gold and platinum are entirely deficient, for they present nothing but a dazzling unbroken surface like a sheet of pure metal. I must assume that everyone knows now-a-days, that these brilliant interference colours—soap-bubble colours one might well call them—of true lustres, are due to the presence of thin films, and the process which gives us the heavy metallic deposits of gold and platinum are opposed to the production of metallic films sufficiently thin to be iridescent. The iridescent films are most easily produced from other metals such as bismuth, silver and copper; precisely because these metals are capable of being tarnished or oxidized in air, while gold and platinum are not. I have here, for instance, thin sheets of the four metals—gold, platinum, silver, and copper; one of these sets has been kept free from action, while the other set has been exposed merely to the action of damp air and gentle warmth. You see at once that the gold and platinum retain their brightness unimpaired; the copper and silver, while they have lost something of their original brightness, have acquired instead, a play of iridescent colour.

The only form of pottery decoration which in my opinion ought to be called lustre, is that which exhibits, besides the metallic sheen, this play of iridescent colour, shewn here on thin sheets of copper and silver, and it would be much better, in my opinion, if our so-called English lustres, made with a basis of gold or platinum, were described as "plated" or "metallised" pottery, so as to avoid the confusion, into which many writers and collectors have fallen, of treating these not very artistic products as if they belonged to the same category as the splendid lustres of old time.

I have said that the problem of making true lustre pottery, is that of obtaining films of metal, generally of copper and of silver, on a fired pottery glaze in sueh a way that the metallic deposit has iridescent colours upon it. The gold and platinum deposits can be obtained with the greatest ease by firing the article coated with the resinous or oily pigment in an ordinary muffle furnace at a clear red heat, for the two noble metals are reduced to the metallic state in the presence of carbonaceous matter; and, when once deposited, they remain absolutely untarnished by the air, so there is no need to exclude the atmospheric oxygen from the kiln. But with silver and copper the case is quite different, for these metals are not so easily reduced to the metallic state as gold and platinum, and even when they are reduced they very readily oxidise and turn black at a red heat unless care is taken to exclude all oxygen. Fortunately, however, silver and copper are capable of forming volatile compounds at a comparatively low temperature, especially in the presence of reducing gases, such as hydrogen, coal-gas, and carbonic oxide; and

these volatile compounds will penetrate or stain into any ordinary pottery glaze, giving a characteristic yellow stain with silver, and a magnificent red stain with copper. Moreover, if the firing and the action of the reducing gas be continued long enough, the yellow or red stains become deeper and deeper in colour, and they finally develop an iridescent film on their surfaces exactly resembling the iridescent films on the sheets of tarnished copper and silver before you. Described in this way, the process of true lustre seems simple enough, yet in actual practice it proves to be one of the most delicate and difficult of all the methods of decoration yet used in connection with pottery, and this difficulty and uncertainty is probably the explanation of the curious fact that after the process had reached a high pitch of excellence in Spain and in Italy it fell into almost complete disuse in Europe, and has only been revived since about 1860.

Where the method was originally invented is by no means certain, but the earliest examples that have been found are those dug up on the site of the city of Rhages, once the capital of the Persian Empire, which was destroyed in the thirteenth century, and those which have been recovered from the rubbish mounds of Fostat, near Old Cairo, by the labours of Mr. Henry Wallis and other Orientalists. In the present state of our knowledge we can only say that the process was probably invented by Egyptian, Syrian, or Persian potters working for the Arabs, and that, in common with many other Oriental arts the knowledge of it was carried through the various countries which the Arabs conquered or over-ran. The process was extensively adopted by the Spanish potters, especially by the Moorish potters of the south and east of the peninsula, and afterwards conveyed to Italy either by Moorish potters themselves or by daring Italian potters who had penetrated into Moorish places in Spain or into the potteries of the East and learned the secrets of the process.*

Although the methods of making lustre used in the Middle Ages appear to have had one common origin, it is interesting to notice how each race of potters developed the methods in their own way so as to arrive at strikingly different results. To consider what is probably the oldest lustre first, that which is commonly known as Persian lustre, and of which there is a magnificent display in the Victoria and Albert Museum, it is interesting to notice that the silver appears to have predominated in the lustreing material, for the films are generally yellowish or brown, the actual red lustre given by copper being comparatively rarely met with. What is so noticeable, however, in the Persian lustre, is the brilliant iridescence and the effect of the metallic rêflet with its predominance of green and rosy tints that are less noticeable in the mediæval lustres made in Europe.

In the Spanish lustres, on the other hand, copper was much more largely used, and everyone must be familiar with the heavy embossed dishes coated with the strong metallic lustre of characteristic copper colour. Silver lustre was, however, used to a considerable extent in Spain, especially in conjunction with patterns painted in underglaze blue. There is one pale brassy tint of Spanish lustre which appears to have been made at Valencia, or in that neighbourhood, and which is almost as characteristic as the glorious copper-red with a brilliant metallic sheen, which was made at Manises, Malaga, and elsewhere in the south. No doubt the English lustres we have already discussed, and dismissed, make a fair approximation in effect to some of the coarser and more metallic kinds of Spanish lustre, but there is the fundamental distinction that the Spanish lustre, strong and metallic as it is in appearance, has at the same time a beautiful play of iridescent colour upon it.

When the Italians learnt the art of lustre making, probably sometime in the fifteenth century, they appear to have first of all contented themselves with making only silver lustre, and the beautiful plates, dishes and vases which are commonly attributed to Diruta and which now have the most beautiful iridescence, like mother-o'-pearl, upon them, form probably the high-water mark that the silver lustre process ever reached, until the present time.

Although there is ample evidence that the Italians were great collectors of the lustred wares of Spain, and a great many of the specimens of Hispano-Moresque lustre ware in modern collections have been obtained from Italy and not from Spain, the Italian use of copper lustre is remarkably different from the use made of it by the Spanish potters. Even where strong copper lustre was used alone by the Italian potters, as in the case of the three famous Gubbio

* Professor Langton Douglas states ("History of Siena," p. 451) that a Sienese potter, Galgano di Belforte, went to Valencia and, disguising himself in mean apparel, learnt the secret of lustreing pottery and then returned with his knowledge to Siena in 1514.

pharmacy jars in the Victoria and Albert Museum, the lustre is far less metallic than the Spanish, while the beautiful ruby-red stain, which is given by the penetration of the copper vapours into the glaze, is much more pronounced. It has been suggested by many writers that the ruby-red was a secret of the potters of Gubbio, and that all the pieces of it which occur have been lustred in that town. We have no means of knowing whether such a belief is well founded or not, but it is certain that the Gubbio potters made great use of the ruby stain, and that in fact, they used it as much for its beauty of colour as for its lustre quality.

At a first glance it would seem as if all these different varieties of lustre, the Persian, the Hispano-Moresque, and the Italian, must be due to some essential difference in the methods or materials used in the different countries, but the experience gained at our own works convinces me that the variations are not any greater than would naturally follow from pursuing exactly the same methods in the haphazard way in which we know the potters of the Middle Ages worked, and that the greatest factors in determining the results were the nature of the glaze and the intensity and duration of the firing.

We possess no information as to the methods used by the originators of the lustre process in the East ; but, fortunately, we have ample evidence left to us, almost accidentally as it may seem, which enables us to reconstruct with absolute accuracy the mixtures and the methods that were used by the Spanish and the Italian potters of the Middle Ages, and as this information never seems to have been properly understood by our English potters and writers, perhaps I may be forgiven for dwelling on it with a certain amount of detail. There is preserved among the treasures in the library of the Victoria and Albert Museum a manual of the Italian potter's art of the sixteenth century, in a manuscript written in 1548 by the "Cavaliere Cipriano Piccolpasso Durantino," as he signs himself on the title-page. The greater part of his interesting treatise is taken up with an account of the methods of pottery making and decorating used in Italy in his time ; but in a supplement he gives us an account of the lustre process, which he did not practise himself, and says : "I know well that it is painted over finished work" (by which he means pottery already decorated in colours and glazed) ; "this I have seen in Ugubio, at the house of one Maestro Cencio.* These finished pieces are subsequently touched with the lustre pigment, composed as follows :—

Rosso Da Majolica.

		A	B	C
Terro Rosso	oz.	3	6	6
Bolo Arminia	,,	1	0	0
Feretto di Spagnia	,,	2	3	3
Cinabrio	,,	0	3	3
Argento Calcinato	,,	0	0	1

"To the second mixture (called 'majolica d'oro') add a *carlino* of calcined silver, grinding them all together (this is C), then place them all in a pipkin, with a *quattrino* (a small copper coin) and fill with red vinegar, in which they are to macerate until the latter is all consumed ; it is then again ground up with more vinegar, and applied with a brush to those parts of the design to be lustred. The process of firing differs from the former one, inasmuch as the pieces are not enclosed in saggers, but are exposed to the direct action of the flames.

"The furnace is differently constructed, the fire chamber square in form, having no arched roof pierced with holes, but only two intersecting arches of brick to support the chamber above, the four corners being left as openings for the free current of the flames. Upon these arches is placed a large circular chamber or vessel, formed of fire-clay, which fits into the square brick structure, touching at the four sides, and supported on the intersecting arches beneath, but leaving the angles free. This inner chamber is pierced in all directions with circular holes, to allow the flames free passage among the wares. The method of building these furnaces is kept guarded, and it is pretended that in it and the manner of firing consist the great secrets of the art. The *scudelli* are packed with the edge of one against the foot of another, the first being supported on an unglazed cup. The furnaces are small, only from three to four feet square, because this art is uncertain in its success, frequently only six pieces being good out of a hundred ; true the art is beautiful and ingenious, and when the pieces are good they pay in gold.

"Only three varieties are produced, golden, silver, and red ; other colours can only be given by the other method (*i.e.*, underglaze painting). The fire is increased gradually, and is made of *palli* or dry willow branches ; with these three hours firing is given ; then, when the furnace shows a certain clearness, having in readiness a quantity of dry broom (*ginestre o vogliam spartio*) cease using the willow wood, and give an hour's firing with this ; afterwards, with a pair of tongs remove a sample from above. Others leave an opening (*vedetta*) in one of the sides, by which a sample or trial, painted on a piece of broken ware, can be removed for examination, and if it appears sufficiently baked, decrease the fire.

"This done, allow to cool, then take out the wares

* This was the son of the famous Maestro Georgio.

and allow them to soak in a lessive of soap-suds, wash and rub them dry with a piece of flannel, when with another dry piece and some ashes (of wood) give them a gentle rubbing, which will develop all their beauty.

"This is all, as it appears to me, that can be said about the majolica, as also about the other colours and mixtures that are required in this art."*

As Piccolpasso fortunately for us illustrated his manuscript with a number of pen drawings, and among these were rude representations of the furnaces used for firing the lustres, I am able to show you how the firing was conducted.

[Here followed some lantern slides showing the style of kiln used in firing the sixteenth century Italian lustres with explanations on the process.]

It will be noticed that although Piccolpasso had no experience in the actual production of lustre decoration, he states that:—

"The method of building these furnaces is kept guarded, and it is pretended that in it and the manner of firing consist the great secrets of the art . . . . because this art is uncertain in its success, frequently only six pieces being good out of a hundred. . . . . true the art is beautiful and ingenious, and when the pieces are good the pay is gold."

Piccolpasso appears to have been doubtful himself whether the Gubbio potters had really told him their secrets and whether they were not pretending when they said that the real secret consisted in the construction of the kilns and in the method of firing. Singularly enough Maestro Cencio, from whom Piccolpasso apparently derived the information, had told him the perfect truth; the mixtures and the methods are quite correct, and so is the statement that in the method of building the furnaces and conducting the firing resides the secret of the art.

Just as we have this detailed information about the Italian processes, Senor Riano was fortunate enough to find in a manuscript in the British Museum a detailed account of the preparation of the Spanish materials which he published in his handbook of the Spanish arts written for the South Kensington Museum more than twenty years ago.†

"Count Florida Blanca, wishing in 1785 to establish at Madrid a manufactory of metallic-lustred ware, had the following report on the actual state of the industry sent to him from Manises with full details of the manner in which it was required to be carried out.

"After pottery is baked, it is varnished with white and blue, the only colours used besides the gold lustre; the vessels are again baked, if the objects are to be painted with gold colour, this can only be put on the white varnish, after they have gone twice through the oven. The vessels are then painted with the said gold colour and are baked a third time, with only dry rosemary for fuel.

"Five ingredients enter into the composition of the gold colour; copper, which is better the older it is; silver, as old as possible; sulphur, red ochre, and strong vinegar, which are mixed in the following proportions: of copper three ounces, of red ochre twelve ounces, of silver one *peseta* (about a shilling), sulphur three ounces, vinegar a quart; three pounds (of twelve ounces) of the earth or scoriæ, which is left after this pottery is painted with the gold colour, is added to the other ingredients.

"They are mixed in the following manner: a small portion of sulphur in powder is put into a casserole with two small bits of copper, between them a coin of one silver *peseta*; the rest of the sulphur and copper is then added to it. When this casserole is ready, it is placed on the fire, and is made to boil until the sulphur is consumed, which is evident when no flame issues from it. The preparation is then taken from the fire, and when cold, is pounded very fine; the red ochre and scoriæ are then added to it; it is mixed up by hand, and again pounded into powder. The preparation is placed in a basin, and mixed with enough water to make a sufficient paste to stick on the sides of the basin; the mixture is then rubbed on the vessel with a stick; it is therefore indispensable that the water should be added very gradually until the mixture is in the proper state.

"The basin, ready prepared, must be placed in an oven for six hours. At Manises it is customary to do so when the vessels of common pottery are baked; after this, the mixture is scratched off the sides of the basin with some iron instrument; it is then removed from there, and broken up into small pieces, which are pounded fine in a hand-made mortar with the quantity of vinegar already mentioned, and after having been well grounded and pounded together for two hours, the mixture is ready for decorating. It is well to observe that the quantity of varnish and gold-coloured mixture, which is required for every object, can only be ascertained by practice."

It will be observed that in this manuscript, while we have a most careful and accurate description of the method of making the lustre pigment, nothing is said of the manner of firing; but there can be no doubt that the Spanish lustres were fired in similar kilns and in a very similar way to the Italian lustres, except that probably the firing was more prolonged.

* In this translation I have followed the excellent version of Mr. Drury Fortnum in his treatise on Italian majolica.

† I am informed by Mr. A. Wenger, of Hanley, Staffordshire, that original of this manuscript is now in the Royal Archives at Madrid.

Mons. L. Franchet,* a well-known French ceramic chemist, has been working on the subject of these old lustres concurrently with but quite independently of my brother and myself, and he has published a re-calculation of these lustre pigments into modern chemical formulæ, which supports the following table of them which I have prepared, though our figures are not identical, which is hardly to be wondered at when dealing with such uncertain substances:—

	Hispano-Moresque.		Piccolpasso* A	B	C
Red clay (red ochre, &c.)	10	..	4	6	6
Sulphide of copper . . .	4	..	2	3	3
Sulphide of silver	1	..	—	—	—
Cinnabar	—	..	—	3	3
Calcined silver	—	..	—	—	1

Mr. De Morgan and some other writers have fallen into a considerable error in the treatment of these old recipes, for Mr. De Morgan says that Piccolpasso's recipes are for the diluent clay only, as he says nothing about either copper or silver, and he surmises that Piccolpasso had been hoaxed by Maestro Cencio.† Referring to the Spanish recipes, Mr. De Morgan says that the pigment contains sulphur, and he assumes that it is entirely different in character from the recipes given by Piccolpasso. I am at a loss to understand these statements, because, as I have shown, the Italian recipes are perfectly accurate, and mention has been made both of silver and copper, while the Spanish recipe contains no sulphur as such. The description tells us carefully that all the excess of sulphur must be burnt off in preparing the pigment, and all that is left is a mixture of the sulphides of copper and silver, which is one of the simplest and best compounds that could be used for the purpose. The idea that because sulphur was used in preparing the Spanish pigment the lustre had something in common with the English gold lustres, made by pouring a solution of gold chloride into balsam of sulphur, was quite devoid of foundation.

* Those who are interested in this subject will find an admirable *resumé* of Mons. Franchet's views in the French Journal "La Ceramique" for April, 1907, which repeats in somewhat fuller detail a paper which appeared in the Comptes-Rendues of December, 1905.

† Mr. De Morgan apparently translated Piccolpasso's "Feretto di Spagnia," as "iron-earth" or "iron ore," but in the famous treatise on glass manufactured by Antonio Neri, published at Florence in 1640 (De Arte Vitraria), the preparation of "Feretto de Spagnia" is carefully described, and the substance is sulphide of copper.

It would be beyond the scope of this paper to enter into any description as to why the lustre process, having been so perfectly acclimatised both in Italy and in Spain in the sixteenth century, should afterwards have fallen into such complete disuse, that Brongniart, when he was writing his great treatise on the ceramic arts in 1840, knew nothing of the ancient practice and could only make some not very sensible suggestions as to how the effect might have been obtained. But although the old lustre process has been forgotton, except probably here and there in remote Spanish or Italian villages where the traditional methods still lingered, the idea of lustre was still present in men's minds, as we have seen from the efforts made in England to obtain effects by the use of gold.

The next step forward was taken about 1856 when a chemist, Brianchon, of Paris, patented a process in France, Germany, England, and other countries for producing beautiful pearly, iridescent effects by the use of salts of bismuth. Brianchon's process was an exceedingly simple one, for he took the thick oily "balsam of sulphur," which was used as the basis of the gold lustre, and dissolved in it crystals of sub-nitrate of bismuth; when this fluid was finely spread over a white glaze, and fired in the ordinary way in a muffle kiln at a very low red-heat with free access of air, it left behind an exquisitely thin film of the bismuth compound which was quite transparent, and gave a very brilliant display of iridescent colours, recalling those on the inside of an oyster shell. Thus Brianchon's lustre achieved a remarkable success for a short time, and no doubt many of you will be familiar with its appearance on the well known Belleek porcelain. Interesting as this peculiar lustre is it cannot be looked upon as a substitute for the genuine lustres we are here to discuss. In the first place the film has no colour of its own, and the iridescence, though delicately beautiful when seen near at hand, is too faint to be really effective. Moreover, the effect was obtained at so low a temperature that the lustrous film is soon destroyed in use, and I have known several pieces of this ware that soon lost their lustre by ordinary washing and cleaning.

As I have already said, there is little doubt that although the true lustre process as used in Italy and in Spain had fallen into disuse the knowledge of the composition of lustres appears to have lingered on. We have evidence that in Spain this was so, because there are modern

Spanish pieces still being made by descendants of the old Moorish potters. Here, for instance, is a dish made by Senor Juan Castan, of Manises, in 1865, and I am informed by my friend, Mr. Wenger, who had this piece from the potter himself, that this family had continued the lustre process on peasant pottery, without interruption, from the Middle Ages.

The actual revival of our own time appears to have been due to an apothecary of Gubbio named Carocci about 1860, and several workmen who had been employed by him went to the Ginori factory in Florence, to the Cantegalli factory, to the factories in the South of France, and, about 1870, one of them named Pietro Gaz or Gazzi was in the Staffordshire potteries endeavouring to sell his secrets. He experimented both at the works of Messrs. Wedgwood and those of Messrs. Minton, and I have seen specimens of the pieces he made there, as well as the manuscript note-books he left behind him. The recipes he gave were perfectly accurate and to all intents and purposes were the same as those given in Piccolpasso's manuscript, but his directions for firing were entirely misleading. In any case he was not successful in the production of saleable pieces, and he left the district early in the seventies. About that time William De Morgan worked out a process quite independently for himself and was the first English potter, so far as I know, who ever made true lustres. Everyone here is doubtless familiar with the splendid pioneer work done by Mr. De Morgan, and as he has already ex-explained his work before the Society of Arts I may be excused for not mentioning it in fuller detail now. I understand that Mr. De Morgan's processes were carried by some of his workmen to other English potteries, and lustres of the same type have since been made by Messrs. Maw and Co. of Benthall, Messrs. Craven Dunnill and Co. of Jackfield, Messrs. J. C. Edwards of Ruabon, and Messrs. Carter and Co. of Poole. Examples produced by each of these firms have been kindly lent to me for exhibition and will be found in the show-cases in the room.

It cannot be said that the practice of these English makers added anything fresh to the development of the lustre process. The methods used by Mr. De Morgan and by the other English potters, were practically the same as those already described, except that I understand china clay was used instead of red earth or red ochre for mixing with the salts of silver and copper to make the lustre pigment. The firing process was also conducted a little differently, for instead of the flames passing through the muffle containing the lustre pieces these were generally fired in a closed muffle of the ordinary type, and when the temperature had been obtained sawdust or wood shavings or dry gorse was thrust into the lower part of the chamber beneath the ware. When this had flared up sufficiently to make a thick smoke in among the pieces, the opening was closed so that the ware to be lustred was given a dense smoke bath of greater or longer duration. In this case, of course, the particles of carbon in the smoke, and no doubt some of the hydrocarbon vapours, produced by the imperfect combustion, act as the reducing agents, and by drawing out, from the apertures in the top part of the kiln, broken shards which have bands of the lustre pigment painted on them, the development of the stain and the reducing film may be watched, and when the fireman deems that the process is complete, the fires are withdrawn, and the process is stopped. Although, as we have said, the practice of the English potters added little or nothing to the lustre process, it must be said that Mr. De Morgan and the other makers produced a type of red lustre which was rather novel, and often exceedingly beautiful, because the ruby stain was generally highly-developed on the pieces and with a much less metallic effect than the Spanish, so that the colour remained more transparent. I do not consider that they have been nearly so successful in the development of the silver lustre effects. Besides this, one gladly recognises that Mr. De Morgan's designs, though based on those of Oriental and Italian potters, have a character of their own, and he undoubtedly set the fashion with a style of design in many respects superior to what had been seen on English pottery before. I must not forget to mention, too, that Messrs. Maw and Co. produced some lustre vases, dishes and tiles from designs by Walter Crane and Lewis F. Day, which were both striking and beautiful.

The next departures in the development of the lustre process were made by the Massiers of Cannes, and especially by M. Clement Massier, some of whose fine pieces are exhibited here. Mr. Massier soon departed from the scheme of lustre designs on a white ground or an ornament left in white on a ground of underglaze blue, and began to lustre the glaze itself. For this purpose he took soft

glazes containing copper dissolved in them, and, after etching the surface with a pattern, or etching away the ground from about the pattern, with hydrofluoric acid so as to get both bright and dull surface of glaze on the same piece, he refired the piece in a smoke kiln at the lustreing temperature, and obtained in this way a great variety of novel and striking effects. His processes were still further diversified by painting silver and copper lustre pigments on the surface of glazes which could themselves be lustred, and so he introduced a number of effects which were altogether novel and in some respects beautiful. Unfortunately, from my point of view, Massier and his artists were rather devoid of taste. The forms of their vases are distinctly ugly, the shapes recalling the shapes of metal rather than of clay, while the ornament itself is generally too naturalistic for the process, and although the Massier processes often gave very beautiful pieces the feeling remains that the beauty was frequently the result of accident rather than premeditated design. Various artists have from time to time left M. Massier's works, and carried his processes to other factories, but without the production of anything really new.

The next important departure was made by the firm of Zsolnay, of Pècs in Hungary, who made a speciality of the ruby stain without lustre, like that produced by Maestro Giorgio at Gubbio in the sixteenth century. In addition to this, which was the most striking of their new departures, they produced a great variety of admirable designs of a quasi-oriental character based on Byzantine, Persian, and Indian motives, in silver and copper lustres on grounds of blue, purple, brown, and white. The display made by this firm at Paris in 1900 was one never to be forgotten, not only for the beauty of many of the individual pieces shown but from the delicacy of the designs and the mastery of the whole process that was implied by such a display. Since 1900, however, the Zsolnay pieces appear to have fallen off in this artistic character; many of the delicate designs are no longer seen in this country, and their pieces too frequently exhibit a garish display of powerful red - copper stain, with a bright metallic green lustre, a colour scheme that, to our English ideas, is barbarically repellant.

During the last year or two fresh attention has been paid to the lustre process in this country, especially by Mr. Bernard Moore, the famous Staffordshire potter, and ourselves, and although we are the best of friends and freely criticise each other's work neither of us knows the process used by the other. I should like to say that I consider many of Mr. Moore's effects not only novel in themselves but strikingly beautiful. Of the work made at our own factory I cannot speak, but there is a collection of it here to-night which may, I hope, speak for me.

I should like, however, to give a short account of the processes that we have found best adapted to the purpose, and such an account may help to clear up certain misconceptions that have been prevalent with regard to the old lustre processes. I have described the old methods and materials as accurately as I can, and I have stated, as the result of my experience, that they will produce perfect and beautiful lustres. There is, however, no reason, so far as I can see, for adopting the old Spanish or the Italian methods for preparing the lustre mixture. All that is necessary is that some compound of copper or of silver, or mixtures of the two, should be mixed with a suitable proportion of some inert substance, which can be either china-clay, or any ordinary red brick clay. It is necessary that the copper or silver compound used shall be pure and of standard composition. The sulphides, oxides or carbonates of the two metals answer perfectly, and they are, on the whole, to be preferred to the chlorides or the nitrates. The mixture of clay and metallic salt having been carefully ground, like any other pottery pigment, can be painted over the fired glaze, using any ordinary potter's medium, that is they can be painted on with turpentine and fat oil, with sugar and water, or, as the mediæval potters did, with vinegar. I believe that generally the Continental practice is to use vinegar, and the Italians profess that no other medium works so well, but that does not agree with our experience. The pattern having been frankly painted on, the pieces are then placed in a special muffle kiln and fired, and that is where, I believe, the most important part of the whole process resides, and where, I think, we have probably made the greatest advances. I may recall Piccolpasso's statement that the firing of the lustre was a very uncertain process, and that often not more than six pieces were good out of a hundred; and I have understood from Mr. De Morgan that, at times, his experiences were almost as disheartening. When we consider the rude and elementary methods used for firing lustre, this is hardly to be

wondered at, because such firing must often have been irregular, with the result that the smoking would be equally irregular too. The first necessity is to design a muffle kiln that can be raised to an even temperature throughout, but that only necessitates careful kiln construction. The next point is the correct ascertaining of the requisite temperature, because the lustreing process takes place at a red heat so low as to be barely visible, and the ordinary trials on which a potter relies for judging the temperature of his kilns are useless, but with a well-constructed kiln and a competent fireman there should be little difficulty in obtaining the proper temperature in a great proportion of the kiln.

The next point is the admission of the reducing gases or smoke. Here again, perhaps, I may clear up a little misapprehension. It has been suggested by many writers that the peculiar beauty and softness of many of the old lustres may have been due to the special fuel that was used for the purpose, and some will have it that broom or rosemary is the only fuel which will produce a suitable smoke for the parpose. Such an idea is quite erroneous. Certainly, if broom is plentiful, it produces a very nice and not too dense smoke; but any kind of wood will produce equally good results, or, as Mr. De Morgan stated, sawdust or shavings will answer the purpose just as well, while even resin and pitch could be used. As a matter of fact, the reduction is much more evenly effected by the use of reducing gases, such as a mixture of carbon-dioxide and carbon-monoxide, or ordinary illuminating gas. For this purpose the muffle is best constructed in iron with tapped pipes passing into and out of the kiln to allow for the slow passage of a current of the particular gas to be used. Then when the correct temperature has been reached, after sweeping out the small quantity of air that remains by a current of carbon-dioxide, carbon-monoxide or coal-gas can be admitted and the reduction takes place very regularly and steadily. It will be found, however, in practice, that it is very necessary to arrange the pieces in the kiln in such a way that the currents of gas are diffused as uniformly as possible through the kiln from top to bottom and from side to side; indeed it is astonishing how difficult it is to avoid the setting up of currents of gas in given directions, so that the pieces are more quickly reduced on one side than on the other. In our own case the temperature, intensity of the reducing gases, and the rapidity of current are so perfectly under control, that our kilns are hermetically sealed through the whole process, and we never draw a trial of any kind.

When the pieces are taken out of the kiln they are still coated with the lustre pigment, which can, however, be easily scrubbed away with soap and water, unless the temperature has been too high, when it will be found that the lustre mixture has been fused into the surface of the glaze, leaving a nasty grey non-metallic film and a spoilt piece of ware.

Certain very interesting effects have been brought to light in the course of our work to which I may direct your attention, particularly as they do not seem to have been mentioned before in any description of the process.

The first effect of the lustre firing is apparently to volatilise some compound of silver, which penetrates into the glaze, giving it a yellowish stain, and this yellow stain is produced long before there is any stain from the copper compound, and whether the kiln atmosphere is reducing or not. On the contrary no stain appears to be developed from the copper until the atmosphere is powerfully reducing, and then the red stain makes its appearance and slowly deepens during the whole time of reduction. Moreover, if the firing is conducted for a long time these volatile stains of silver and of copper slowly spread over the whole of the glaze surface, so that if you take a perfectly white vase and cover its surface fairly well with a foliated pattern in silver or in copper the ground of the piece may become entirely yellow or red as the case may be. Another thing that is very noticeable is the greater ease with which silver gives lustre than copper. It follows from this that where mixtures of silver and copper are used together the actual quality of lustre produced will depend not so much on the nature of the mixture itself as on the temperature and duration of the firing. It is quite possible, indeed, by under-firing a mixture of silver and copper to produce an effects which would lead anyone to suppose that the lustre had contained silver alone. A great deal has also been said as to certain glazes being much better for lustreing upon than others. There is some truth in this idea, but not very much, for we have found it perfectly possible to produce excellent lustres on glazes of every type; leadless glazes, lead glazes, and glazes with or without oxide of tin. The only type of glaze which seems to be impermeable to the stain of silver and of copper at the lower temperature required for the effect is the felspathic glaze

of hard-paste porcelain, and that I suppose is the reason why the Chinese have never used the lustre process in the decoration of their porcelain.

Having stated as clearly as I can how both the old and the new lustres were made, it now remains to add that of course the value of the lustre process depends entirely on the artistic use of it. The effects of lustre are so beautiful in themselves, and may be made so striking and powerful, that the dangers attendant on its misuse are probably greater than with any other process in the decoration of pottery. Having reduced the scientific and mechanical sides of the process to something like order and method, it is our earnest endeavour to use the beautiful results that have been placed in our hands in such a way as to produce a new English pottery as artistic and beautiful as that of the Middle Ages. To this end we have gradually gathered together what I may describe as a school of young English artists, all of whom have had some training in various art schools of the country under the control of the Board of Education. Every piece of lustre pottery we produce is unique, for either the designs are original conceptions or adaptations of the painters themselves, or in cases where we have been fortunate enough to obtain designs from distinguished decorative artists like Mr. Walter Crane no two pieces are reproduced in the same way. Notwithstanding the perfection to which the chemistry of the process has been brought the method must always remain liable to variations, which also serve to give variety to the pieces. As in old times the best pieces are not made by invention alone, because out of a dozen pieces equally well-painted and fired one perhaps will have a quality surpassing all the rest. Yet I never look on a collection of fine lustre pieces, such as has been exhibited here to-day, without in my mind parodying two lines of Omar Khayyám:—

> "I often wonder what the potter buys
> One half so precious as the things he sells."

DISCUSSION.

The CHAIRMAN said that personally he felt, while listening to the paper, he had been at school again. He had come to the conclusion that, before the paper was read, he understood nothing whatever about lustre pottery, but now he would be able to boast that he understood everything about it. The best of the paper had been the way in which the author had taken the audience into his confidence by telling them the secrets of the manufacture of lustre pottery, in order that they might go and do likewise; but he thought when they had done so, and had produced pottery similar to the magnificent specimens shown, it would be found that Mr. Burton was producing an article greatly in advance of what they were then producing. He entirely agreed with the author that the metallic ware he had shown was not lustre ware; and if it was invented by his (the Chairman's) distinguished great, great grandfather, he was glad he gave it up. The pottery shown by Mr. Burton was entirely different, and had a beauty which had no relation to metallic substances or to the ordinary pottery glaze or enamel. The great beauty of lustre ware was that it had all the advantages of shape and design of ordinary pottery, and in addition, the great added virtue of light. The iridescence of light on the pieces exhibited came as an absolute revelation to him. He had been brought up to admire Florence and De Morgan ware, but they seemed to have become already out-of-date. It was all very well for scientific people to produce such things, but personally he desired to see them produced as a commercial business.

Mr. H. H. CUNYNGHAME, C.B., thought it was impossible to look at the exhibition of pottery collected by the author without feeling that lustre pottery was, to a large extent, the pottery of the future. Almost all the extraordinarily beautiful colours which could be produced by the methods described by Mr. Burton ought to play a very large part in ordinary household pottery, such as jugs, and ornaments of all sorts. Art ought to be progressive; but, in looking at the ordinary crockery, one could not but feel that the manufacturers were merely children at the work, and only at the beginning of art. There seemed to be no reason why, from the simplicity of the process described, ordinary crockery, jugs and basins and so on, in this country, should not be decorated to a large extent. Of course, it was impossible to use works of art for the common things of life; but he really believed that great steps forward in art would be made in this country. He expected he would be in his grave before they occurred, but he hoped his ghost would come back and have the pleasure of looking at the great advance which he was sure would be made in the arts of life, and all the mechanical industries. He was one of those who entirely believed in the future; he was not a pessimist at all, because he believed, in a few years hence, the most extraordinary changes, socially and industrially, would take place. He made the author's acquaintance, some years ago, in connection with the Home Office work; and at that time there was a movement on foot, conducted by benevolent and philanthropic people, who strongly urged that the use of lead in pottery should be absolutely forbidden, because a certain

number of the potters were poisoned. It was thought by those who were advising the Government, that it was possible to use lead without danger; and that it was inexpedient to forbid the use of an important ingredient in the production of the potter's art, unless every attempt had been exhausted to show that the article could be safely used. The pottery trade owed a debt of gratitude to Mr. Burton, not merely for the inventions he had made, but because he was one of the leading men in the industry, who showed by his extreme moderation his willingness to meet every suggestion made by the Home Office. By his breadth of view he prevented rash action being taken in the total abolition of lead. Wiser counsels now prevailed. He was not in the secrets of the arcana of the House of Commons like the Chairman, who knew better than he did the temper of that assembly; but he hoped they would not rashly press changes upon departments which, if carried out, would ruin a national industry. The use of lead was almost essential in certain manufactures, to those who knew how to use it, it being impossible to produce the finest class of work without its use. In the beautiful specimens exhibited by Mr. Burton that evening, a considerable amount of lead glaze had been used, and it would, therefore, be a thousand pities if anybody pressed upon the industry a total prohibition of that material. Of course any department could require that manufacturers who used lead should use it as chemists did, with discrimination, fans and ventilating apparatus being adopted, and care taken that the hands were washed. If people took every precaution in their handling of them, the most dangerous chemicals could be used with perfect safety. It was to a great extent due to the authorities not being aggravated but helped by Mr. Burton that a solution was brought about by which, under certain conditions, lead glazes continued to be used in this country. He desired, in the next place, to make a few remarks in connection with English art. He had been mixed up with educational movements since he first came to London, and remembered the various artistic movements which had taken place, both in London and the provinces, for the last thirty or thirty-five years. Great mistakes in teaching had undoubtedly been made, perhaps the greatest of all being the peculiarly English one of a tendency to go in for fads. In the different schools masters and teachers were to be found who were full of all sorts of curious fancies. The master of one school told him that the theory he adopted was that all boys should evolve art for themselves; they were not taught styles, but were asked such a question as, "How would you, out of the depths of your inner consciousness, decorate a tea cup?" He saw a little boy evolving a style, which the master thought was beautifully original until he (Mr. Cunynghame) pointed out to him that it was the design on the staircase of the building. It was almost impossible to evolve designs out of one's inner consciousness; the greatest designers thought themselves lucky if they produced one good original drawing in a month; and most people had to be content with patching up, or making a slight alteration in, old styles which had come before them. Another fad was to take up a particular art, and for people to say that nothing was good but Etruscan or Celtic. There was good and bad art in every age, but he believed the English nation possessed greater artistic possibilities than any other nation, certainly than the Germans and the modern Italians, though there were still some good artistic people among the mere peasants of Italy. The French seemed to have gone hopelessly wrong, principally on matters of colour. At the present time, they seemed to be losing their national sense of colour. Therefore he thought the art of Europe, in the future depended, to a great extent, on this country. He was certain that lustre pottery would be enormously developed, and that it would meet with large sales. He hoped high prices would be obtained, and that the development of the art would prove to be one of the future sources of national prosperity. England would have to give up making cheap matches, and cheap twopenny things of a small character; the Japanese and Chinese would soon take all that work off their hands; but the thing they would not be able to take out of the hands of the people of this country was modern English art, such an excellent representation of which had been exhibited by the author.

The CHAIRMAN believed that most of the articles exhibited contained heavy lead glaze, but he desired to point out that Messrs. Pilkington, of Clifton Junction, were one of the few firms who had so far escaped without a case of lead poisoning of any description. In spite of using heavily leaded glazes, by looking after the cleanliness of their shops and workmen, and paying attention to ventilation, they had avoided the occurrence of any such evil.

Mr. PHENÉ SPIERS referred to his acquaintance with Mr. De Morgan, and that gentleman's first attempts to produce lustre pottery. Mr. De Morgan had two entirely different moods. He was the son of Professor De Morgan, the great mathematician, from whom he inherited a strong scientific tendency, and he was also a very great artist. Those two moods were always agitating him first in the one way and then in the other. At one time he would be more pleased with the variety of colours, which the accidents of the furnace had produced, while at other times when in his scientific mood he preferred the more perfect firing. He thought Mr. Burton was working on the right lines in endeavouring to evolve a style of his own. In all the pieces exhibited the author had tried to work out new designs and not to imitate the works of earlier potters. He thought the members were under a deep debt of

gratitude to Mr. Burton for the great pains he had taken in writing the paper, and the information he had placed at their disposal.

Mr. WALTER F. REID enquired what chemical combination took place when the particular stage of the firing was reached to which the author had called attention. Among many interesting samples which Mr. Burton had specially prepared for exhibition, one apparently did not show the copper at all, but at the other end of the series one piece was over-fired. Could Mr. Burton state in what form the copper existed there? Mr. Cunynghame had shewn in the lectures he had given at the Society that very beautiful enamels could be made by the silicates of the metals. Were the coloured surfaces shown by Mr. Burton silicates upon which a very small quantity of the metal had been reduced on the surface, or in what form did it exist? It was not a true enamel, but one with a certain undefinable play of colours upon it, which was not the same as when, for instance, metals were enamelled with a true silicate. The author used the expression more than once that the colouring matter stained the glaze over the rest of the body of the ware. Was not that to a certain extent a volatilisation of the material? He was thinking for the moment of the iridescence that was produced on glass by the volatilisation of chlorides in the furnaces. There it was clearly the volatilisation of the ingredients, and a beautiful iridescence was produced on glass in that way. Perhaps the author could give some information with regard to the particular nature of the glaze which was produced on the surface of enamel, if he might so call it. He did not think that the vermilion, or cinnabar, used by the old potters in their composition, was entirely useless. It would puzzle modern chemists to find a better diluent which would volatilise at the same temperature as sulphide of mercury. There was a risk in olden times, when potters had not the same technical means as modern potters possessed, unless a diluent were used. Such things were used at the present day. For instance, at the present time if a gardener wished to sow grass seed he mixed it with sand and earth; and therefore the old potters when they were pottering about probably found by actual experiment that cinnabar was a material which would volatilise in the heat of the furnace, and they simply used it to dilute their lustre or enamel.

Mr. BURTON, in reply, said there were many chemical theories as to what caused the stain. The old people thought it was a silicate of the oxide or sub-oxide; but he was not at all sure it was a silicate. His own impression was that it was probably a metal, *i.e.*, either pure metallic silver or pure metallic copper, which went in as such, was held in suspension, and stained the glaze. It had been imagined that the beautiful ruby stain of copper was due to some oxide of copper, but that was all theory. Dr. Mellor had been experimenting on this subject to find out whether it was due to sub-oxide or metallic copper, but he did not know whether a satisfactory conclusion had been arrived at. Personally he thought the metal was volatilised at a much lower temperature than they had been in the habit of supposing, and, under those circumstances, it stained into the glaze, producing, in the case of silver, a yellow film, and, in the case of copper, a red film. What could be done in that way by the volatilisation of the staining material, whatever it might be, was well exemplified in some pieces he had exhibited. Mr. Reid's remarks that cinabrio was an exceedingly good diluent because it volatilised at a low temperature might be true, but in his (Mr. Burton's) opinion its use was unnecessary; it was employed for the reasons he gave in his paper. The clay was the diluent, and the old potters used precisely the same proportion of clay in the mixtures to which they added cinabrio as those to which they did not. He had made experiments which proved that the cinabrio volatilised and disappeared; it had no effect whatever upon the pottery.

Mr. C. H. BRENNAN inquired whether the lustre pottery was made with a china or terra cotta body.

Mr. BURTON replied that it was perfectly immaterial which was used. He had not seen a piece of lustre pottery made on hard-paste porcelain, because it was impervious to the metallic stains at the low temperature at which the things were made. China clay was merely a convenient diluent to add to the metallic compound for the purpose of getting something with which to paint. Red-brick clay, whitening, ground-up sand or ground-up coal ashes could be used.

Mr. E. C. CORBIN (Messrs. Goode and Co.) asked what was the best glaze to use.

Mr. BURTON said that Mr. Cunynghame, who had had a good deal of experience with glazes, had rightly said that most of the glazes he (the speaker) used were heavily leaded. Those glazes had a surface and a texture which no other glaze in the world possessed. There was a tremendous difference between a leaded glaze and a leadless glaze, whether it was a hard-paste porcelain glaze, or the leadless glaze which had been made in response to a rather clamorous public. Beautiful results could be obtained with both, but the one was not equal to the other. The old Persian lustre was made on leadless glaze, and some of his (the speaker's) pieces were on leadless glazes, but the Hispano-Moresque and the Italian majolica were made with glazes more heavily leaded than any used in England to-day. The only glaze that which seemed to be antipathetic

to the lustre process was that of hard-paste porcelain, which consisted of little more than fused felspar.

Mr. VAN DE PUT inquired whether it was not the fact that the Arabians and the Moors were unable to obtain a red pigment.

The CHAIRMAN, in proposing a hearty vote of thanks to Mr. Burton for his extraordinarily interesting paper, said he did not know whether all the papers at the Society of Arts were of an equally interesting character; if they were he was afraid he would be a very bad attender at Parliament in future. He first knew Mr. Burton when that gentleman was a chemist, and he (the Chairman) was in short coats; then Mr. Burton became a man of business and started a new factory; then he became an artist, and subsequently a public-spirited man who looked after the interests of the pottery industry as a whole; and, last of all, he found he had written the only readable books giving a history of the production of earthenware and porcelain—books not merely to be taken up and read by the individual who was a specialist in china, but of real interest to anyone who took an interest in art; and the paper he had just delivered fully came up to his great reputation. Mr. Burton had taken a great deal of interest in the pottery societies of North Staffordshire, which looked after the question of lead poisoning; he was always travelling about the Continent, finding out the methods of competitors abroad, and bringing back all that was best for reproduction at Clifton Junction. At the same time he was always willing to give the benefit of his inventions and his views to his brother potters; and the work he, his brother, and Bernard Moore had done between them in developing the artistic as opposed to the commercial side of English pottery could not be overrated. He only hoped that, having developed the artistic side to such an extent as he had done, he would further develop the commercial side of the beautiful invention he had described.

The resolution of thanks was then put, and carried unanimously.

Mr. BURTON, in reply, said it had been a very great delight to him that Mr. Wedgwood had taken the chair, because his first knowledge of pottery came from his labours as a chemist to the Chairman's relatives. He considered Wedgwood the greatest potter of England, and it was a very great honour and pleasure to him that anybody of the name of Wedgwood had taken the chair. He desired to thank Mr. Cunynghame for his presence and his very frank and outspoken views, especially with regard to English art. He had known Mr. Cunynghame as a public official for a great many years, and knew that the English pottery trade owed him a debt of gratitude for helping them to settle their difficulties with the Home Office in the sensible and practical way they were able to do some years ago. He also knew that Mr. Cunynghame had been an earnest student of art in this country, and that he was absolutely correct when he said that English people were apt to suffer from aberration of taste, and form a fantastic notion of art. The English nation was suffering from a profound belief that everybody but English people could make artistic things. In his opinion England was at the present time producing finer artistic work in almost every branch of decorative art than any other nation, but the English people who ought to be buying it were allowing the best pieces to be exported. On the other hand, English people went on to the Continent, came back with some wretched trumpery which was not worth buying, and said, "See how artistic the Frenchman or Italian is!" In conclusion, he desired to express his indebtedness to the many friends who had lent him specimens for the purposes of exhibition, and to the authorities at the South Kensington Museum for a similar courtesy.

The following is a list of the examples of pottery lent for exhibition:—

Victoria and Albert Museum (lent by the Board of Education):

Glazed earthenware dish, majolica lustred. Italian, fourteenth to fifteenth century.

Enamelled earthenware plateau, Hispano-Moresque in gold lustre, fifteenth or sixteenth century.

Enamelled earthenware plateau, Hispano-Moresque with shield of arms and arabesque in front. fifteenth century (Valencia).

Water bottle, blue glazed earthenware in metallic lustre, Persian, fifteenth or sixteenth century.

Dish of lustred earthenware, by William De Morgan, English, nineteenth century.

Cream coloured enamelled earthenware dish, lustred and painted in blue, with eagle in relief in centre, bearing a shield of arms, Spanish, nineteenth century.

Cream coloured enamelled earthenwere vase, lustred and painted in blue with arabesque ornament, nineteenth century, Spanish.

Bowl, glazed and lustred earthenware, Clement Massier, French, nineteenth century.

Vase, iridescent green glaze, Zsolnay, Hungarian, late nineteenth century.

Messrs. Thomas Goode and Co., 17, South Audley-street, W.—A collection of very fine specimens of old English lustre.

Bernard Moore, Esq., Stoke-on-Trent.—A collection of modern examples of his lustre ware.

Messrs. Liberty and Co., Regent-street, W.—A collection of lustres by Zsolnay and Co.

A. Wenger, Esq., Etruria, Stoke-on-Trent.—A collection of modern Spanish, Italian and French lustre pieces.

Messrs. Morris and Co., Oxford-street, W.—Examples of De Morgan and Cantegalli lustres.

Messrs. Maw and Co., Jackfield, Salop.—A collection of lustre vases and tiles.

Messrs. Craven Dunnill and Co., Jackfield, Salop.—A collection of lustre vases and tiles.

Messrs. Carter and Co., Poole, Dorset.—A collection of lustre vases and tiles.

William Burton, Esq.—A collection of pieces by Clement Massier, Jerome Massier, Cantegalli, De Morgan, Maw, and other makers.

Lewis F. Day, Esq.—A collection of lustre pieces, by Clement Massier and Zsolnay.

Pilkington's Tile and Pottery Company, Limited, Clifton Junction, near Manchester.—A collection of their new Lancastrian lustres.

Mr. WALTER C. HANCOCK writes:—It would be interesting to know whether any analyses have been made of the surface layers of specimens of old lustre pottery, and if so, what light they throw upon the materials used in its production, assuming that the metallic component to which the lustre is due is present in sufficient quantity to be definitely estimated. As the "lustreing" temperature is 650° C, and the melting point of copper is about 1100° C, which is of course far below the melting points of other metals used to produce lustre, such as silver or gold, it appears probable that to some extent definite chemical combination occurs between the metal and the glaze, since the latter is penetrated by the former. On this point the microscopical examination of a transverse section of a specimen of lustre ware would possibly give a good deal of information. From Mr. Burton's experience it seems to be clear that the lustre effect is produced by two factors, a temperature of 650° and a simple reducing atmosphere of carbon monoxide, for example, and that the products of destructive distillation of carbonaceous material, which would occur when broom or brushwood was used for firing the kiln, are not necessary for obtaining the result. Mr. De Morgan has pointed out that the combustible, however, must be free from sulphur. It seems somewhat curious that from the writings of Piccolpasso a red or ferruginous clay was used in the pigment, whereas Mr. Burton and others have employed simply a white clay. It would have appeared probable that the amount of ferric oxide present in a red ochre or ferruginous clay would have produced a marked effect upon the character of the lustre. A possible explanation of the absence of any apparent effect may be, that the ferric oxide is reduced by the surrounding atmosphere of reducing gases to the ferrous condition, and in that condition unites with the silica of the glaze.

ARTS AND CRAFTS.

Home Arts and Industries at the Albert Hall and Earl's Court.—Attention has been called during the last few weeks, both at the Albert Hall and at Earl's Court, to what are called "home arts and industries," and it is interesting to consider the relation of such crafts or industries practised in widely different lands, both to each other and to production in general. It is easy enough to laugh at efforts made to promote home industries, and to say that the days of anything but manufacture on a large scale are numbered. It is also, unfortunately, easy to find fault with some of the methods employed by enthusiastic would-be helpers of such industries, and to point to sufficiently serious defects in some of the work turned out by the less satisfactory of the "home art" classes. For all that, home arts in their larger sense have come to stay. If we look around us we see not only that our English Home Arts and Industries Association has perseveringly exhibited its products for a goodly number of years, but that work of much the same kind is being done all over Europe. Of course, things are differently managed in different countries. While in a country which, like our own, is highly developed industrially, it is very largely a question of teaching the cottager new crafts or reviving old, all but forgotten, trades—the effort in more backward lands is merely directed towards keeping industries already well established from being driven from the field by the competition of factory and machine labour, or to finding a larger market for peasant work. The strong feeling in favour of the preservation of race characteristics, the increased interest taken in ethnography, and the tendency in certain quarters to cry out for decentralisation, have all had their share in the fostering of these home arts—and the prevalence of international exhibitions has enabled us to see how universal the movement is, and has tended to increase its impetus. At Milan last year, peasant crafts from various countries were well represented, and at present at Earl's Court we have a very good opportunity of seeing what is being done in this kind of work in that part of the Balkan Peninsula which has been comparatively recently freed from the dominion of the Turk. The most important exhibit of this kind of work is probably that in the Servian section of the Pirot Carpet *Zadruga*—a kind of co-operative association. The workers, who are women, carry on their trade in private houses, and the society is aided by Government capital. Bulgarian carpet weaving is represented by a working exhibit of the Royal School of Carpet Weaving. It is evidently not only in the British Isles that doctors disagree as to the relative merits of working with or without a pattern, for while the Servian weavers use no sketches or drawings whatever, the Bulgarians all have their designs carefully attached to their looms in a prominent position.

Both from Servia and from Montenegro come exhibits of peasant embroidery and hand-loom weav-

ing. The embroidery is mainly, of course, in tent stitch and cross stitch, curiously un-Western and yet not quite Eastern in character. It is really more nearly allied to Hungarian and Transylvanian work than to anything else—though it has some affinity with that which comes from the islands of the Ægean. The Montenegrin work exhibited is executed mainly by the students of the technical school of Cetinje, which is under the patronage, nominally at least, of Princess Yolanda (granddaughter of Prince Nikola, of Montenegro).

It is, of course, from one point of view, very satisfactory to see that home industries all over the world are being supported and encouraged—that they are even (as we saw at the South African Exhibition) being introduced into fresh countries. It constitutes a by no means unnecessary protest against the triumphal progress of the machine, and it points to an interest in a simple form of artistic craftsmanship which has too often been neglected or despised. Nevertheless, the very extent of the movement ought to give us pause here in England. We are talking a good deal just now of the beauty of hand work, of the joy of individual production—we are encouraging art students, who have their living to make, to dabble in crafts, urging unoccupied women to turn their attention more or less seriously to what is often called "art work," and inducing the peasants in our rural districts to take up lace-making, wood-carving, or what not, in their unoccupied time. So far as all this is looked upon as healthy recreation of a more or less educational kind there is nothing to be said against it and much to be counted in its favour. Can we be sure that from the economic point of view the movement is equally to be commended? Is the ordinary British buyer of home art handicraft productions open-handed enough to support this movement? Will his patriotism take him (or her) to the length of paying five or six shillings for say the trimming for a blouse embroidered in England where money is plentiful and the standard of living is high, when he can get something "very nearly as good" imported from Macedonia, or Servia, or Hungary or somewhere else where money is scarce and the cost of living is low, for three shillings or half a crown? We may hope so without any very strong conviction that it will. And if not, is there not, or will there not be at no very distant time, at least a possibility of something not so very unlike sweating in these crafts which we are encouraging so vigorously? Is it quite safe to insist upon the claims of hand-work to beauty and originality without insisting no whit less persistently upon its claim to be paid for? There seems to be a likelihood that if we fail to educate public opinion in this matter we may be doing more harm than good in trying to revive hand production on anything like a large scale.

Artists at Work.—We have reached the time of year when, with the beginning of summer, the more commercial side of Arts and Crafts falls into the background and such more or less amateur exhibitions as the show of the Home Arts and Industries Association and the Society of Artists at Work come to the front. After all the season spells something not unlike frivolity—and, though the various collections on view at this time of year are not by any means uniformly frivolous, we feel that it is fancy-work, lacemaking and other crafts, connected rather with personal adornment or the furnishing of a summer bungalow than with the permanent decoration of the home, that are now claiming attention, and getting it.

The Society of Artists at Work held their May exhibition at Knightsbridge this year instead of at the Grafton Gallery. Naturally many of the exhibitors were the same as on former occasions, and there was a certain sameness about a good number of the exhibits. The novelty of seeing people actually working at their trades in an exhibition building palls after a time. It is not possible to introduce new crafts every six months in order to stimulate the interest of the frequenter of exhibitions. Still, the scope of the show has been somewhat widened this spring, and several methods of ornamenting fabrics, &c., were to be seen for the first time.

Lace, Textile Decoration, and Jewellery.—Lace and embroidery were amongst the most amply represented arts. Irish, Buckinghamshire, and Devonshire laces were shown in fairly large quantities, but the most interesting exhibit in this section consisted of reproductions of the famous quilt of Henri II. in *filet brodé*. The original of the quilt is now at Paris, in the Cluny Museum, and is one of the greatest treasures of that storehouse of old embroidery. (It is rather difficult, by the way, to make up one's mind whether this work should be classed as lace or embroidery—it really comes under either head.) It was interesting to see finished reproductions of the squares of which the coverlet is composed and also the small frames with the work in different stages of progress, with the threads of the "filet" firmly attached to their sides while the work of putting in the pattern was started.

The other fairly new departures in textile work are very different in character. Poker work on velvet, though it may lend itself to making peacock feather designs on a greeny blue ground, is not a very serious form of art. Painting on linen in washable paint looks rather attractive, but it is difficult to banish from one's mind the feeling that patterns so executed must inevitably wash out. Stencilled sunshades afford an opportunity of producing really very pretty effects of colour.

There is a good deal of embroidery on linen and it is pleasing to note that several exhibitors seem to have adopted a definite style to which they practically confine themselves. One show was composed almost entirely of work of a pseudo-Epyptian character, another of characteristically Oriental embroidery, a third of reproductions and adaptations of Jacobean

crewel-work, and yet another of appliqué of linen on linen in a style reminiscent of the works of Miss Anne Macbeth.

The bulk of the silver work was made up of buckles, chains, brooches and other jewellery, but there was one large cross of silver and blue-johnstone which was both pretty and interesting. An exhibit consisting mainly of hornwork in various colours proves that we are learning over here to work in a material which used to be considered to belong almost exclusively to the French. Of course, this is not the first time by any means that English hornwork of this kind has been shown, but the exhibits are now on a larger scale than heretofore.

OBITUARY.

SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.—Sir Dietrich Brandis died at Bonn on the 28th ult., after six months illness. Sir Dietrich was elected an Honorary Corresponding Member of the Society in 1896. His first connection with the Society was as far back as 1872, when he took part in the discussion on Mr. James Collins's paper on "The Study of Economic Botany." Of late years after his return from India he took an active interest in the Society's work. He presided at Mr. Herbert Stone's paper on "The Identification of Wood," in 1901, and spoke in several of the discussions on Forestry.

He was a son of Dr. S. A. Brandis, Professor of Philosophy at Bonn University, and was born in 1824. In 1856 he was appointed Superintendent of the Forests in Pegu, and in 1864 he was made Inspector-General of Forests to the Indian Government. This office he held until 1883, when he retired from the service. In 1887 he became Director of the Practical Course of Forestry on the Continent, in connection with Cooper's Hill, and this appointment he held until 1896. He was made a C.I.E. in 1878, and received the K.C.I.E., in 1887. In 1875, he was elected a Fellow of the Royal Society.

GENERAL NOTES.

PHOTOGRAPHIC DARK ROOMS.—The *Photographic Monthly* for June contains in addition to its usual contents a list of dark rooms in England and abroad where the travelling photographer may change his plates or develop his plates and films. The list of English rooms is a long one, but the Continental list might be largely extended, as numerous tourist resorts where such facilities exist are not mentioned. But, though far from complete, the list will doubtless be useful to amateur photographers who like to develop as they go along. Experience, however, with regard to Continental dark rooms shows that in the tourist season their proprietors are often too busy to allow the use of their rooms to outsiders though they are ready enough to advertise that they do so. There is more profit to be made by developing Kodak films than by lending rooms for their development.

LETCHWORTH HOUSING EXHIBITION.—The preparations at Garden City, on the site of the Urban Housing and Rural Homesteads Exhibition, which is to be opened in July by the Marquis of Salisbury, are reported to be far advanced. Three sites of ground have been set apart at Letchworth for the Exhibition; two for the creation of rural homesteads and small holdings buildings, and one near Letchworth Station for urban cottages, ranging in cost from £175 to £250. There will probably be some fifty houses erected of at least thirty different types, and these should form a great attraction to visitors from London and elsewhere who are interested in questions of housing reform and model cottages. The Exhibition is much more comprehensive in its scope than was the 1905 Cheap Cottages Exhibition, and, besides comprising cottages of a higher value and wider range than before, an exhibition of manufacturing implements, dairy implements and appliances, builders' merchants' materials, temporary buildings, fowlhouses, beehives, food stuffs, &c., will be held. Some of the principal furnishing firms of London have also undertaken to completely furnish numbers of the cottages, and an important Photographic Exhibition will be held during the three months that the Exhibition is open. Mr. R. Winfrey, M.P., is responsible for a set of small holding outbuildings, which are being erected by the South Lincolnshire Small Holdings' Association. The Concrete Machinery Company will be represented by a house, utilising local sand and cement, the blocks being manufactured on the site.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 10...Geographical, University of London, Burlington-gardens, W., 8½ p.m. Dr. Otto Pettersson, "Oceanic Circulation."

TUESDAY, JUNE 11...Medical and Chirurgical, 20, Hanover-square, W., 8½ p.m.
Colonial, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. The Hon. Thomas Bent, "Victoria and its Resources."
Horticultural, Vincent-square, Westminster, S.W., 3 p.m. Mr. W. P. Wright, "Arches, Pillars, and Pergolas."

WEDNESDAY, JUNE 12...Biblical Archæology, 37, Great Russell-street, W.C., 4½ p.m.

THURSDAY, JUNE 13...Royal, Burlington-house, W., 4½ p.m.
Antiquaries, Burlington-house, W., 8½ p.m.
Mathematical, 22, Albemarle-street, W., 5½ p.m.

FRIDAY, JUNE 14...Astronomical, Burlington-house, W., 5 p.m.
Physical, Royal College of Science, South Kensington, S.W., 5 p.m.

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FRIDAY, JUNE 14, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fifty-third Annual General Meeting for the purpose of receiving the Council's Report and Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 26th June, at 4 p.m.

(By Order of the Council),
HENRY TRUEMAN WOOD,
Secretary.

H.M. THE KING OF DENMARK.

The Council of the Society having elected H.M. the King of Denmark an Honorary Royal Member, H.R.H. the Prince of Wales, as President of the Society, graciously communicated to King Frederik the fact of his election, and has now received from His Majesty the following letter of acceptance:—

Buckingham Palace,
June 11th, 1907.

SIR,—I have great pleasure in accepting Your Royal Highness's kind invitation to become an Honorary Member of the Society of Arts, of which You, as its President, have given me such an interesting description in Your esteemed letter of the 4th instant.

I am very glad to meet the wishes of your Royal Highness and those of the Members of the Society of Arts, in associating myself with this old and useful Institution, and have the honour to remain, Sir,

Your Royal Highness's
Most faithful friend,
(Signed) FREDERIK,
King of Denmark.

His Royal Highness
The Prince of Wales.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

A programme of the arrangements for the evening will be published in due course.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

INDIAN SECTION.

Thursday, May 30, 4.30 p.m.; CHARLES EDWARD HOBHOUSE, M.P., Under Secretary of State for India, in the chair.

The CHAIRMAN, in introducing the reader of the paper, said the subject to be discussed was one of great interest, not only to those who were immediately connected with India, but to all who had watched the experiments conducted in that country, which they thought might be repeated on a useful, it not so large a scale, in other parts of the world.

The paper read was—

IRRIGATION COLONIES IN INDIA.

By LAURENCE ROBERTSON, I.C.S.

GENERAL DESCRIPTION.

The subject on which I have been invited to address you this afternoon is that of the Irrigation Colonies in India, with reference more especially to the three great colonies that have been established in recent times—the Chenab colony and the Jhelum colony in the Punjab, and the Jamrao colony in Sind. The area commanded by the three canals that give their names to these settlements, and upon which they depend for their existence, amounts in the aggregate to over 8,800 square miles, an area which is comparable with the extent of one-third of Scotland. Of the total, the Chenab colony, with 5,300 square miles, is by far the largest; the Jhelum colony comes next with 2,000 square miles, while the Jamrao lands cover 1,500 square miles.

The colonisation of such vast territories, practically uninhabited, almost the whole of which was at the unfettered disposal of the State, which were known to contain land of the highest fertility, and where successful agriculture can only be practised by the aid of irrigation, is a subject which lends itself to treatment from many different points of view. There is, first of all, the engineering problem of bringing the water from the rivers over the area commanded in its many aspects. The river, from which the canal is to derive its supply, must be harnessed by a dam, which, while allowing the surplus waters of the summer floods to pass down the channel, will enable the engineer to hold up, and divert into his canal the scanty but precious supplies of the winter season, when the water is at its lowest. The alignment and construction of the main canal and its many branches, down to the village watercourse, so as to make the fullest use of the water available in the most economical way, present problems of great difficulty.

Happily I am relieved from entering into any discussion of these matters, for I find that in April, 1902, Mr. Sidney Preston read before this Society a paper entitled "Recent Developments in Punjab Irrigation," in which he fully explained the grand work which the State engineers in India have been able to accomplish, in making the waters of the great rivers of the Punjab and Sind available for the fertilisation of the vast plains, arid and uninhabited some fifteen years ago, which now present a picture of contentment and affluence.

Starting then with the fact that the engineering problem has been solved, and that the vast uncultivated plains can be rendered fertile by irrigation, the special aspect of the colonies to which I propose to devote myself this afternoon concerns the methods adopted for peopling these tracts and for securing the prosperity of the colonists. It was evident that this work could not be entrusted to the ordinary staff of the districts in which the tracts traversed by the irrigation systems lay, and for each of the three colonies which I have mentioned the Government appointed a selected member of its service as Colonisation Officer, and entrusted him with the whole arrangements for attracting settlers, allotting them land, and nursing the growing settlements to success. This appointment was made for the Chenab colony in 1892, for the Jamrao colony in 1898, and for the Jhelum colony in 1901, and colony work in the three areas may be said to have commenced from these dates.

THE SQUARE SURVEY.

Before actual steps could be taken to bring the settlers, it was necessary for the Colonisation Officer to survey his vast estate and to lay it out in villages and holdings of convenient size. The system adopted was to demarcate over the whole area a series of squares, which are either of 27, 25, or 16 acres in extent, so that the map at first prepared resembles a chess board. This square forms for all three colonies the unit of revenue management for colonisation purposes. It is the unit of allotment for all classes of settlers,

and the system of irrigation channels is so arranged that each square has a separate inlet for water from a water-course. In the following remarks a square always refers to this unit. I do not wish to detain you by entering into the details of this survey system or to give a long account of the difficulties encountered and the hardships endured by the Colonisation Officer and his Indian surveyors in carrying it out. But when it is remembered that the survey parties often worked across vast stretches of uninhabited country, where the only source of water supply might be a brackish well 100 feet deep, and that in order to complete the work it was often necessary to remain in the field throughout the hot season when the temperature rises to over 110° Fahr. in the scanty shade of the scrub jungle with which parts of the country was covered, it will be realised that powers of organisation, energy and determination were required from the officer in charge and great devotion to duty from the Indian surveyors under him.

It will be convenient here to anticipate for a moment the arrival of the settlers. I have spoken of the square as the unit of allotment, but each square is too large for the purposes of irrigation if water is to be used economically and if crop registration, upon which depends the amount of land-and-water-tax each cultivator will have to pay, is to be efficiently performed. Along the sides of each square, therefore, points were demarcated, and by carrying small ridges across the square it is divided up into small fields, each of approximately one acre in extent. The convenience of this measure was not at first realised in the Chenab Canal, and considerable tracts had already been colonised before it was devised, but experience soon showed that, unless some uniform system of sub-division was enforced, water would be wasted and the cultivators would be helpless to protect themselves from being fleeced by the staff which measures up the cultivation and assesses the taxes to be levied at each harvest. Sub-division is now rigidly insisted on from the beginning and the measure is of immense practical importance in effecting economy in the use of water and in protecting the cultivators from illicit demands, while at the same time immensely increasing the efficiency of the inspecting officers, who can see at a glance whether the amount of cultivation has been correctly registered. This system was not evolved and finally brought into operation without an immense amount of trouble and scrutiny of details. For on the one hand the incoming colonists were often disinclined to spend time and labour upon work that seemed unnecessary to them at first, but they soon grasped the convenience of the system, and the work was done; on the other hand, the system of squares, however carefully laid out, was constantly diverging from the true, and re-measurement and re-calculation of areas had often to be done before the exact size of these internal fields was ascertained, and an accurate map produced.

After the whole area to be colonised in any particular tract had been subjected to a square survey, it was necessary to divide it up into villages of convenient size, the average gross area being between 1,500 and 2,000 acres. This work was done by the Irrigation Department, the main principle followed being that the lands in each village should be irrigable from its own water-course to the exclusion of all other lands, and that each such water-course should take off from a Government channel. The boundaries of the villages, where they were not canals, distributaries, roads, drainage channels, or the like natural features, were coterminous with the lines or diagonals of the squares.

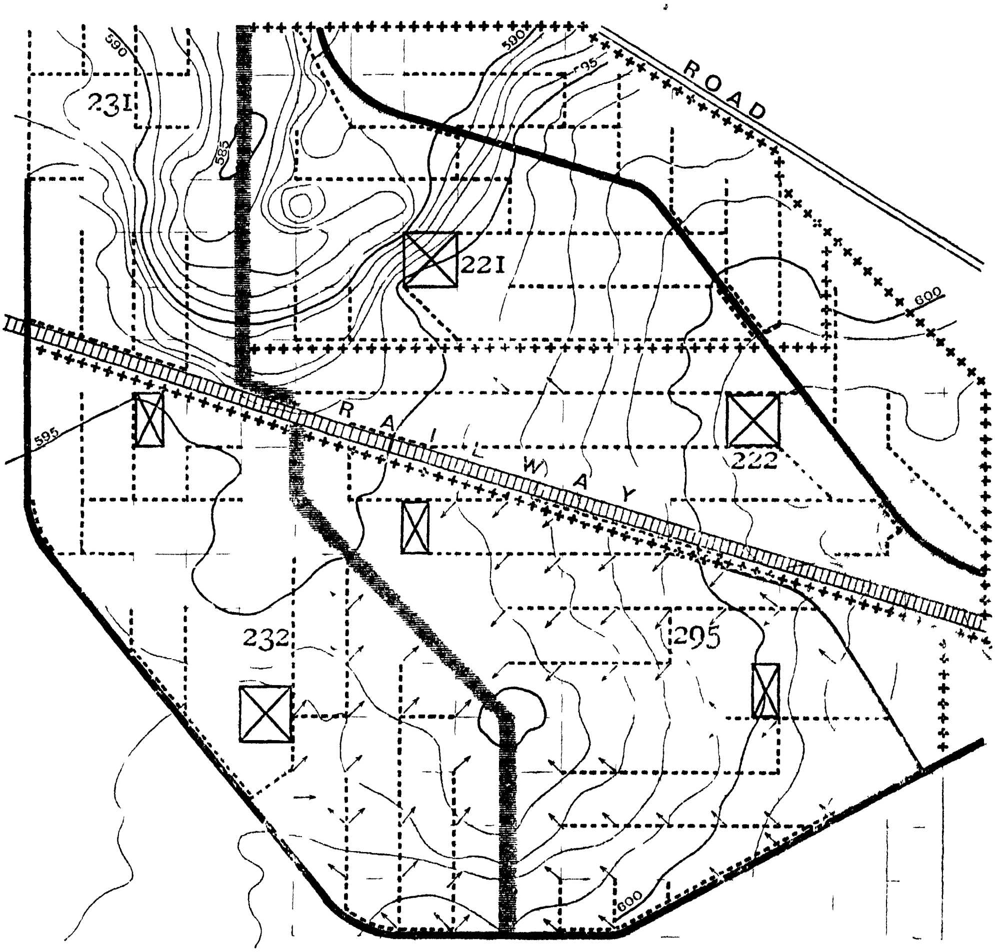
When the Colonisation Officer had received his village maps he marked off a plot for the village site, an area of about 20 per cent. of the village lands for grazing and communal purposes, and the remainder he held available for allotment to the incoming settlers. The map below, shows at a glance how the waste lands were divided up into squares and villages laid out. (Fig. 1.)

Terms of Allotments.

The Chenab.—While all this work was going on, the important questions of the classes of settlers to be invited to take up land and the terms of the grants were under discussion and settlement. In the Chenab colony the object in view was two-fold, first to relieve, as far as might be, the pressure on the land in some of the densely populated districts of the Punjab, and, secondly, to colonise the area available with the best types of Punjab farmer who would cultivate their own holdings as far as possible without the aid of tenants, and ultimately constitute healthy agricultural communities. It was decided to divide all grantees into three classes—peasants, yeomen, and capitalists. Each peasant was, as a rule, offered one square in the Punjab, or about 27

acres, each yeoman four or five squares, or 104 to 130 acres, according to his capacity, and each capitalist a larger area up to 500 acres. All grants are on a provisional footing for three years, during which the grantee must prove his capacity and determination to succeed by bringing his allotment under cultivation. At the expiry of that period, if the grantee has complied with the terms of the grant as to clearance and residence, a peasant is given a permanent right of occupancy in his holding, which is hereditary but inalienable by gift, sale, will, or mortgage, and a yeoman was at first given complete proprietary rights, but is now given the restricted tenure of the peasant, while the capitalist receives full proprietary rights. No fee is charged to the peasant in return for the grant of occupancy rights; the yeoman generally pays a small premium of Rs. 4 or Rs. 5 an acre, while the capitalist is required to purchase his proprietary rights for a payment per acre which varies directly

FIG. 1.



Drainage depression ▮ *The fine lines indicate contours at intervals of 1 foot*
Government Channels ▬ *Watercourses.....* *Village site* ☒
Areas too high to be irrigated tinted thus
The small arrows indicate the commanding point of each square, from which each cultivator will receive his supply to the best advantage. A few only are shown to prevent confusion
No of Village thus- 295. Boundary of New Villages-. +++++

with the number of squares in his grant. In all cases the grantees have to pay for the expenditure incurred by Government on the survey and on the construction of the village water-courses. Two harvests are allowed free of all State demands for revenue or water-rate to all new settlers, and liberal terms of payment are arranged for all initial demands, the peasants more especially being assisted by State advances repayable on easy conditions. Peasants are required to reside in the village in which their holdings are, and yeomen on or close to their grants, while capitalists may either take up their residence on their grants, or appoint approved resident agents. There are also other special classes, who were given allotments on special terms; as, for instance, Mahzabi Sikhs—a class which supplies the best recruits for the pioneer regiments of the Indian Army—and camel-grantees, who consisted mostly of the original nomad graziers of the tract. The latter were given allotments on condition of maintaining for each square allotted a camel suitable for army transport work.

The Jhelum.—The Jhelum colony was at first intended to be colonised on exactly the same lines, but before work had begun it was decided, on the recommendation of the Horse-breeding Commission, to start a huge experiment with the object of ensuring a steady supply of horses for the Indian Army. A great portion of the area available was reserved for settlers, who, in addition to complying with the terms imposed upon the grantees in the Chenab colony, would undertake to maintain, in proportion to the area of each grant, a number of mares passed as fit for breeding army remounts. The selection of colonists had, therefore, to be carried out not so much with reference to agricultural capacity as with reference to natural aptitude for horse-breeding. This change will no doubt lower the agricultural efficiency of this colony in comparison with the Chenab, but the horse-breeding industry appears now to show good prospects of success.

The whole of the horse-breeding work has been placed under the supervision of the Army Remount Department, its officers acting as assistants to the Colonisation Officer. The settlers' mares are served free of all charge by Government stallions located in the colony, and Government has a lien on all produce up to one year of age on the payment of a fair price.

The Jamrao.—For the Jamrao colony it was determined to rely mainly on the Punjab for settlers. Sind itself is already for the most part under-populated, and the distribution of the available land among the inhabitants of the province would have meant the depopulation of the tracts from which the settlers came. The claims of the indigenous agriculturists were, however, by no means neglected, and it was only after their requirements had been fairly and considerately met, that the remainder of the area available was reserved for foreigners from other parts of India. The agricultural methods of Sind, more especially of the parts neighbouring on the Jamrao lands, were inefficient, and it was hoped that the importation of superior agriculturists would lead to the introduction of superior methods among the indigenous farmers, a hope which has to a great extent been justified. The conditions of the grants were modelled upon the Chenab terms, and the same classes of grantees were invited to take up the land.

One class of grantees on this canal may be given a few words of special notice. When Sind came under British rule all the younger branches of the Talpurs, the then reigning family, were pensioned off either with grants of land rent free or with cash stipends. In most cases these pensions were to be discontinued or reduced after a period of years or on the death of the original grantee, in the hope that the descendants would in time find means of earning their own livelihood without State assistance. As time went the families grew, while the source of income steadily diminished. The descendants showed little power of recognising their altered position, and, notwithstanding the efforts of the authorities to encourage habits of industry and thrift by education and other means, there were large numbers of young Talpurs who would not work or who could find no congenial employment and who were reduced to the very verge of destitution. The thing threatened to become a social evil of some magnitude. The opportunity was, therefore, taken to reserve a portion of the Jamrao lands for selected young men of the Talpur families. To make matters easier the conditions were somewhat relaxed in their favour; they were given free grants of money to start them, and it is gratifying to find that the policy has met with some success. But they are not popular with the Colonisation Officer, who wants to see his lands used to the best advantage, while the Talpurs are for the most part absentee landlords, taking very little interest in their estates.

Grants to Government Servants.

In addition to the classes of colonists which I have mentioned, considerable areas were reserved on all these canals for native Government servants of all departments, the class of grant given being arranged according to the status of each individual; thus a private soldier would ordinarily rank as a peasant, a native officer as a yeoman, and an official of higher grade as a capitalist. Specially meritorious service may be rewarded by the remission of the initial payments due.

Colonisation Methods.

I have now briefly described the arrangements made for the reception of the colonists in their new homes, the classes of settlers required, and the conditions upon which the land was offered for occupation. The working out of the scheme devolved upon the Colonisation Officer.

The land was there, and the water that was to fructify it. But before the one could be successfully applied to the other there was an immense amount of manual labour for the incoming colonist to perform. He was relieved of all work in connection with bringing the water to his holding. That had all been done before his arrival. But the land had to be levelled or cleared, the field ridges thrown up to divide his holding into one acre plots, and many other tasks performed, before actual cultivation could begin. Besides he had to construct some sort of shelter for himself and his family—not, of course, a permanent abode; the construction of that came later, but a rude temporary hut which would serve until a harvest or two had put money in his pocket and had assured him that his new home would be permanent. An isolated Indian peasant would have found it impossible to do all this single-handed. It was, therefore, determined to base operations as regards peasants at any rate on the caste organisation of India, in other words, the colonists in each village were all of the same caste or tribe drawn from the same neighbourhood at home, and villages allotted to the same caste or tribe were grouped together in large blocks. Thus each settler arrived in his new home not as an individual but as a member of a group, and he had around him friends, possibly relations, from his old district, or, at any rate, men with whom he was connected by the ties of common social customs and habits. This organisation immensely facilitated the execution of the preliminary work to which I have alluded, and was in no small measure the cause of the astonishing rapid success of the peasant settlements. The principle is less applicable to yeomen grantees and still less to the capitalists, and this difference may, to some extent, explain the less rapid success of the settlers of these classes.

It was fortunate for the Punjab that within easy reach of the Chenab, the first colony opened for settlers, there were districts densely populated with some of the finest husbandmen of India where the *morcellement* of the land had been carried on to great lengths. A great land hunger had already established itself, and the peasantry of those districts was composed of fine husbandmen of the very class that it had been decided to recruit for the new colony. It was to these districts, therefore, that the Colonisation Officer first turned for his settlers. As was natural, some hesitation was shown at first, but when once a crop had been harvested by the early colonists, the success of the venture was assured. The Colonisation Officer was thronged with eager applicants hurrying to share in the benefits already enjoyed by their more fortunate brethren. He was, of course, unable by himself to distinguish the good from the bad among this eager throng, and from the first he relied upon the Deputy Commissioners of the districts selected as recruiting grounds to chose the peasant groups for him. The system adopted was for the Colonisation Officer to send to the Deputy Commissioner information concerning the area available for distribution to inhabitants of his district, the caste or tribe, and the number of settlers required. It was usual for the Deputy Commissioner to send one or two leaders in the first instance to spy out the promised land. If their report was favourable, as it almost always was, volunteers were forthcoming in numbers, and the Deputy Commissioner sent the selected men in a body to the Colonisation Officer on a pre-arranged date. They were then given their allotments. Selection of the higher classes of colonists was generally subject to the sanction of superior authority, and as a rule they arrived in the colony as individuals and not as members of a group.

The isolated position of Sind made the task of importing settlers somewhat more formidable. It was decided to reserve the greater part of the land available for colonisation from outside the province for settlers from the Punjab of the class that had made such a success of the Chenab colony. But, owing to the great distance of the promised

land from the homes of the pioneers, special arrangements had to be made, and, moreover, as the indigenous agricultural population of Sind is almost entirely Mussulman, it was thought best to confine recruitment mostly to followers of the Prophet in the Punjab. The Colonisation Officer first enlisted in his favour the services of one or two leading men of the selected classes who had made a success of their grants in the Chenab colony, and who, therefore, had experienced and overcome the difficulties of settling in a new home under similar conditions. He brought them down to Sind at State expense, and showed them over the Jamrao lands. He then returned with them to their home districts, where by their influence he was able to recruit a sufficient body of suitable men, and as the settlers could not be expected to find their way to Sind unassisted, he arranged with the railway authorities for special trains which brought not only the settlers themselves, but their families, their cattle, their agricultural implements, and their household goods. After the first batch of colonists that had been imported in this way had settled down and reaped a harvest or two, it was found unnecessary to make special arrangements. The fame of the new canal soon spread, and colonists were able to find their way to the ground unassisted.

Hardships and Difficulties of the Early Settlers.

After his arrival in his new country the lot of the early settler was not free from hardship and difficulty. It was inevitable that in opening irrigation works of such magnitude small mistakes should occur. Land allotted on the promise of water was found to be uncommanded; the water would not flow over it by gravity, and the settlers had to be shifted to other parts. Another more frequent cause of hardship was that in many cases the soil which appeared to be fertile was found to be irresponsive to the early efforts of the colonists, and the Colonisation Officer had great difficulty in deciding claims for fresh allotments, for on the one hand all could not get land of the very highest fertility, as they would have liked, and on the other it was essential to make the early settlers prosper as quickly as possible. Then, again, though the tracts colonised were practically uninhabited, they were frequented by cattle- and camel-breeders, who resented the presence of the new-comers on their grazing grounds, and who made their resentment felt by stealing the cattle of the foreigners. Such harassment was most severely felt in the Chenab. Then, again, a number of bad characters found their way into the colony, even amongst the most carefully selected groups, and with the slackening of social restraints to which they were accustomed in their old districts, they took the more easily to evil courses. Moreover, the exposed position of the early settlers in their temporary shelters invited attack by thieves, and the Chenab colony at any rate was for some years at the beginning distinguished for a heavy record of serious crime.

Disease, too, was not absent. The opening up of ground that had lain undisturbed by the plough for centuries, and the pouring over the land of water gave rise to malarial fever of a virulent type, and at some seasons of the year the inhabitants of whole tracts were in the early days prostrated and unable to do any work at all. I have myself, at the first harvest after the opening of the Jamrao Canal, ridden through hundreds of acres of ripe crops ready for the sickle which were being destroyed by the birds or the beasts because scarcely a single individual was able to leave his bed on account of fever.

The Jhelum colony was particularly unfortunate. For in the third year of its existence not only were the autumnal fevers of a very severe type, but in the following spring the settlement was devastated by a virulent outbreak of plague. The new colonists fled to their old homes, and could only with difficulty be persuaded to return when the outbreak had abated. The Colonisation Officer himself nearly lost his life in the epidemic, and his most experienced Indian assistant was one of its early victims.

Perhaps one of the most formidable difficulties of all was connected with a supply of drinking water. When the canal was flowing, good water was, of course, obtainable. But Government channels have to be closed for considerable periods so as to allow the engineer to carry out his system of distribution, and once a year the water has to be shut off from the whole irrigation system for a considerable time to allow of repairs and clearances to the main channels. During such periods the early settlers were often in great straits and the authorities anxious. In the first instance the difficulty was got over by allowing the villagers to fill from the canal tanks which they were urged to excavate. The persuasive powers of the Colonisation Officer were often

taxed to the utmost to get these tanks dug; threats and even compulsion of a mild sort had not unfrequently to be resorted to. At best, however, even when tanks are reserved for men and cattle separately, a tank is an insanitary source of drinking water for human beings. As soon, therefore, as the settlers had settled down and begun to prosper, each village was urged to provide itself with a well for drinking water. Government advanced one-half of the cost and the remainder was raised by the villagers from among themselves. I find that in the Chenab colony almost every village has now its own drinking well.

In all these matters the colonists found a sympathetic friend in the Colonisation Officer. Water-courses were re-aligned or improved wherever necessary; exchanges of land were readily given when the first allotment was found to be uncommanded or really infertile. Special measures were taken to prevent cattle theft; and here I may mention that the best method of prevention was to give the thieves themselves land to cultivate. Not only was the nuisance thus mitigated, but these graziers, who had had no experience of cultivation, soon settled down to their new occupation and are now reported to be almost as fine cultivators as the skilled peasant with centuries of agricultural tradition behind him. The police administration was strengthened and the statistics of crime became more normal.

Thus, in a thousand different ways, the Colonisation Officer attended to the wants of the settlers, and helped them to tide over the hardships of the first years. Every colonist who imagined he had a grievance of any sort, turned to him for assistance and advice. His office was daily thronged with malcontents, and it required immense patience and great tact to listen to all, and send them away satisfied. Of course, there was some whom nothing would satisfy, and desertions were common in the earlier days of both the Chenab and the Jamrao, but the number of the desertions bore only an infinitesimal proportion to the total number of the settlers.

Laying out New Villages.

In short, the great majority of the new-comers soon settled down in the new colony, and threw in their lot definitely with it. With their increasing prosperity came the desire to build substantial houses, and it was one of the early duties of the Colonisation Officer to plan out a village site in which the settlers could make themselves comfortable according to their own ideas, and that would at the same time conform to the elementary rules of Western sanitation. A new plan for a model peasant village is reproduced below (Fig. 2). The plan varies, of course, with the class of colonists in each village. For a village inhabited by peasants, it is essential to adopt a village plan which would afford light and air everywhere, but closed in as far as possible from the outside as a protection against thieves. Each landholder should have a separate site, extensive enough to contain not only a dwelling-house, but a cattle-yard and a grain store, while a separate site, somewhat apart from the main body of the village, must be reserved for the lower castes.

The plan reproduced was first devised for the Chenab colony, and has been adopted with minor alterations for other colonies. Each landholder was given a plot 120 by 80 feet. The headman probably had two. Four shop sites were provided. A central plot was reserved for Government use which serves the purpose of the common meeting place for all, and separate parts of the village are reserved for artisans and low castes. The main roads are 80 feet and the side roads 40 feet in breadth. In order to afford protection the exterior sites were allotted first.

This model is subject to variation to suit the requirements of different classes of settlers. For a village inhabited by yeomen or capitalists each grantee requires a site capable of accommodating not only his own household, but his tenants and their families. Again, grantees, who are bound by the terms of their grants to maintain camels for Government service, require a different type of settlement, in which the outer boundaries are occupied by the dwelling-houses, thus forming a spacious walled enclosure, in which the camels can be tethered in lines.

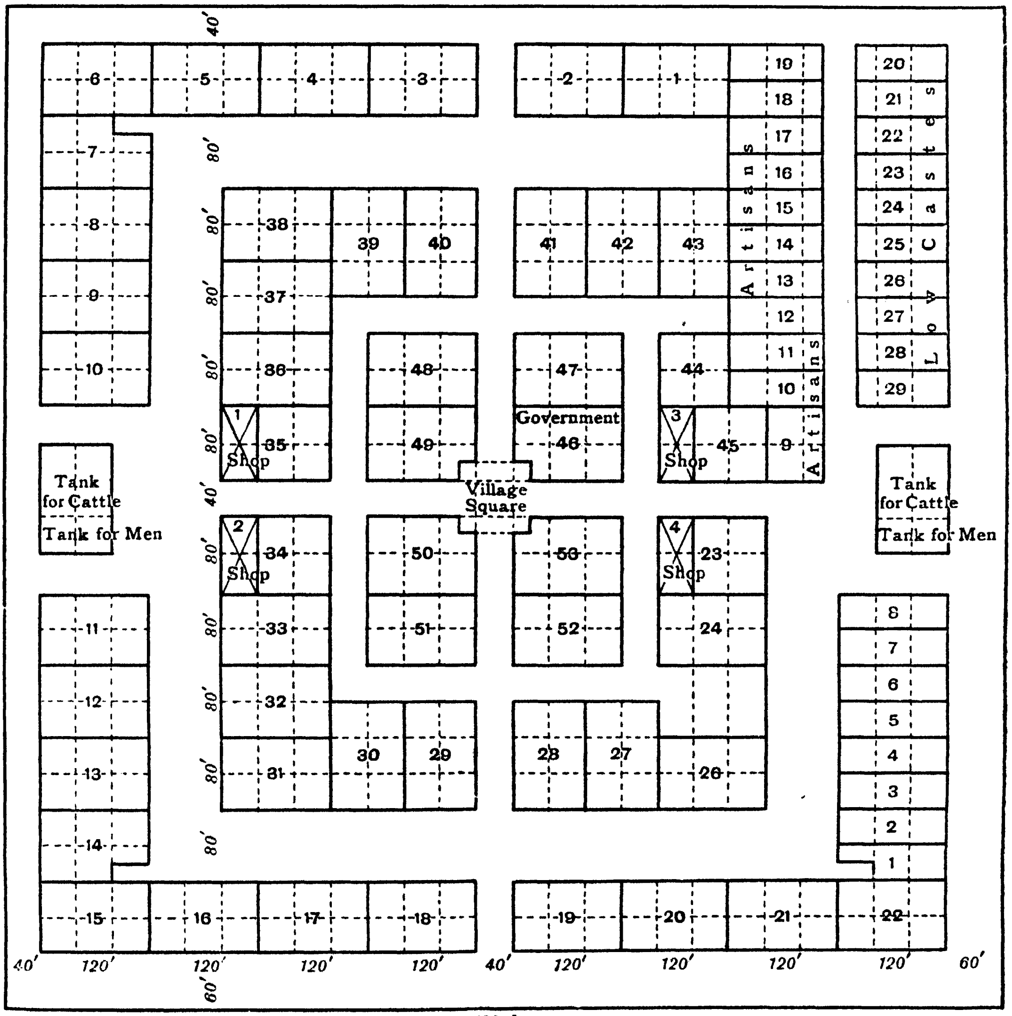
Village Sanitation.

In the plan the tank is a prominent feature. But as I have already explained this source of drinking-water supply is gradually being abandoned everywhere for the more sanitary well, but a tank will be retained for the use of the village cattle and other live stock.

In other ways, the sanitation of the village sites has been attended to. Manure is stored outside the village site. Hollows likely to retain putrid water are being filled up, and the Colonisation Officer of the Chenab colony, writing in 1902, was able to say that the people

themselves were beginning to take an interest and pride in the sanitation of their villages. In some parts of the colony there has already arisen a state of rivalry for the possession of the smartest and cleanest village site, and the people themselves maintain sweepers, whose sole duty is to keep the streets and lanes clean. The matters. In the main, however, the Punjabi peasant colonists reproduce replicas of their own home system. Headmen have been appointed by Government, and are rewarded by the allotment of an additional square of land for cultivation, in addition to the usual percentage on collections received in the

FIG. 2.



1100 feet

Government has recently made annual grants for the promotion of good sanitation. Thus these colonies may in time afford conspicuous examples of good village sanitation, which may serve as models for sanitary administration in other parts of India.

VILLAGE ORGANISATION.

In other ways the colonists have showed themselves open to new ideas in village Punjab. In a colony where to some extent every one considers himself as good as his neighbour, these useful officials do notpossess the prestige which attaches to the office in an old village with its ancient traditions. But where the principle to which I have alluded prevails, viz.: populating each village by a group bound together by the ties of kinship or caste, and where the office has been given to the leader of the group, the headmen still

possess real power and influence, and are able to carry on their duties efficiently. In Sind, however, where home influences are more remote and where to some extent the principle has been disregarded, the headman system shows signs of breaking down partly on that account and partly for the reason that the system of revenue management in Sind has never recognised the headman to the same extent as has always been done in the Punjab. Apart from this, however, the internal organisation of the new villages is, even in Sind, modelled closely on the home system. The colonists bring their carpenters, blacksmiths, potters, water-carriers, washermen, and the like, partly because they find them more trustworthy than outsiders, but mainly on account of the very large and hereditary part which these menials play in the social life of a peasant village, for, in addition to carrying on their own occupations, all have special duties or privileges at birth, marriage, and funeral ceremonies.

I have already shown that the importance of recognising this factor in the colonists' life was given effect to in planning the village site, but they were encouraged more especially by the reservation of a square or two of cultivable land in each village in which each is allotted a few acres for cultivation under the supervision of the headman of the village. No permanent rights in this area are granted to individuals, but the headmen allot from harvest to harvest to each artisan or menial working for the colonists generally a plot for cultivation. It was feared that this plan would fail, but up to the present no formidable difficulties have arisen, and in Sind, at any rate, it has been found to work well.

Scarcity of Labour.

Notwithstanding these arrangements, however, all three colonies have suffered to some extent from a scarcity of agricultural labour. In the Chenab the low caste Dedhs from the surrounding districts supplied the want at first and occupied a very strong position, but in later years they have been ousted to a large extent by the relatives and caste fellows of the landholders themselves. The initial years of the Jamrao synchronized with a period of famine in the adjoining parts of Rajputana and immigrants in search of labour were plentiful. But the last year in Rajputana was a good one, and the colony is apparently face to face with a serious scarcity of labour. Indeed, complaints of difficulties in this respect are heard from all three colonies.

Some Social Changes.

While conforming in the main to their traditional village organisation, the colonists have not remained unaffected by their new environment. Thus in social matters, which are generally so rigidly ruled by custom, some curious changes are mentioned. For instance, the peasants of the Gurdaspur district of the Punjab, where burnt bricks are not regarded as auspicious building material, are now using them freely on the Chenab Canal in the construction of their houses; and Arian (Mussulman) women of the Jullundur district now consider voluminous trousers a necessary article of gala attire, while in their original home they are never worn. Again it is noted that the Sikh religion is making much headway in the colony, partly owing to zealous proselytism by retired Sikh pensioners of the native army who have settled in the colony. These are small details gleaned from passing remarks in official reports, and I have no doubt that the colonies will afford a field of interesting study to the ethnologist of the future.

Some Statistics of Material Prosperity.

We may now turn to a consideration of the material prosperity of the colonies. The Chenab colony, which is the oldest, presents the greatest degree of prosperity, and as it has been constituted a separate district, we have more complete statistical data for it than for the other two colonies. I have, however, no intention of inflicting upon you a long series of figures, and it will be sufficient to give the broadest statistical results. The last census of the Chenab colony, taken about nine months ago, showed a total population of 858,000, and it was computed that in 1903 the colonist had exported produce by rail to the amount of 2¾ millions sterling, a figure which must be greatly exceeded by now. The area irrigated annually has risen in 10 years from 270,000 to nearly 2,000,000 acres. Taking all three colonies together the latest available statistics for 1905-06 show that the area supplied with canal water was over 2½ million acres, and that the total value of the crop raised was at a very low estimation over 4 million sterling. This last figure is based on the official estimate of the out-turn of crops, which is notoriously

below the mark, and I think it may be safely said that the total value of the crop was nearer 6 millions sterling, and as the gross capital cost of all three irrigation systems was somewhat less than 3½ millions sterling, the value of the crop raised in that one year was almost double the capital cost of the works. The value of the land in the hands of the colonists has increased enormously in value. Auctions have from time to time been held and we find that agricultural land that at the beginning of operations on the Chenab fetched under £3 an acre will now sell for as much as £20 or £30.

COMMUNICATIONS.

These figures naturally lead to a consideration of the equipment of a colony in its commercial aspect, the provision of means of communication and the construction of towns and marts. As regards internal communications, it has been the custom to reserve broad strips of land 60 feet to 80 feet wide for main lines of highways, and strips of lesser width for inter-village and field to field communications. Such strips were reserved to the State from the first, and considerable progress has been made in metalling the main roads in the Chenab colony and in bridging all roads throughout. In a country intersected by a network of irrigation channels, the provision of bridges over all classes of road is a matter of serious consideration. In the Jamrao, the problem was solved by carrying every road as outlined over every water channel met with before settlers appeared, and part of the expense was subsequently recovered from them. But on the whole I venture to think that the provision of good means of communication throughout the colonies has not kept pace with their development. In all three road metal is unobtainable, except at great expense, as it has to be brought from great distances, and I have always thought that they presented a splendid field for the construction of light feeder railways, which ought to prove very remunerative. All three are well served by branches of the North-Western Railway, but the question of easy internal communication and the rapid transport of agricultural produce to the stations on the main lines of railway still requires consideration.

TOWNS AND MARTS.

On the other hand, the problem of providing towns and marts as collecting and distributing centres for the trade of the colonies, has been very successfully dealt with. The chief town of each colony is at the headquarters of the local administration, Lyallpur—in commemoration of a famous Lieutenant-Governor of the Punjab—being the name given in the Chenab colony, and Sargodha in the Jhelum colony, while on the Jamrao the headquarter station is at the old town of Mirpur Khas, which even before the opening of the canal was a place of some importance. At each of these centres it was necessary to provide not only for a new trading town but also a civil station for the officers of the colony. The map below gives a good idea of how such a town and station has been laid out. It represents Sargodha which is the last of its kind. (Fig. 3.) It will be observed that this plan provides not only for a European settlement and a native town both conveniently situated for the railway station but also for public offices, recreation grounds, and public gardens.

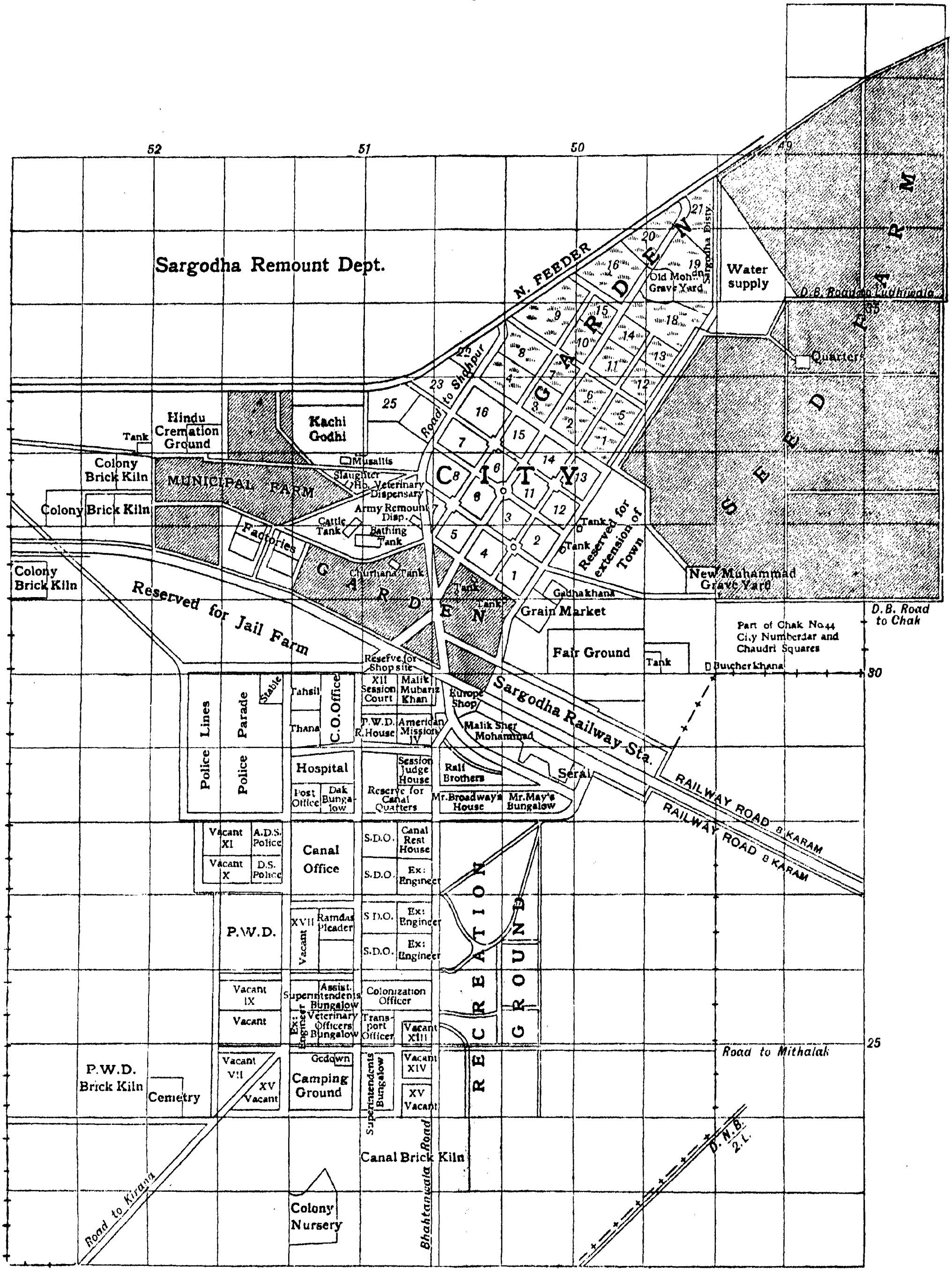
The planning of the native towns themselves gave scope for much ingenuity and thought. The way in which Lyallpur city has been laid out is shown in the map below. (Fig. 4.)

You will observe that Lyallpur is based on an octagon, a shape that has been found to give trouble when the town expanded beyond the limits at first fixed for it. In other more recent towns the square has been adopted as the basic figure. All, however, have been planned so as to provide wide straight bazaars, spacious grain markets, sites for public offices, schools, hospitals, and veterinary dispensaries, and other requirements of modern town life.

In addition to these chief cities each colony possesses a number of smaller towns, mostly situated at railway stations. These have been laid out on less ambitious lines than the chief cities, and are chiefly intended to provide collecting centres for the export trade of the neighbourhood. The magnitude of that trade in one article alone is reflected in the exports of wheat from Karachi, the value of which has risen from 2¼ millions sterling in 1898-99 to 8 millions in 1904-05.

In giving out building sites in all colony towns, whether by allotment to applicants as in the beginning or by putting up the lease to auction as is now done, strict conditions are enforced as regards structural and sanitary requirements. All the buildings in the main streets and bazaars are required to be of burnt brick, and designed in accordance with a uniform pattern, so that Lyallpur for instance

FIG. 3.



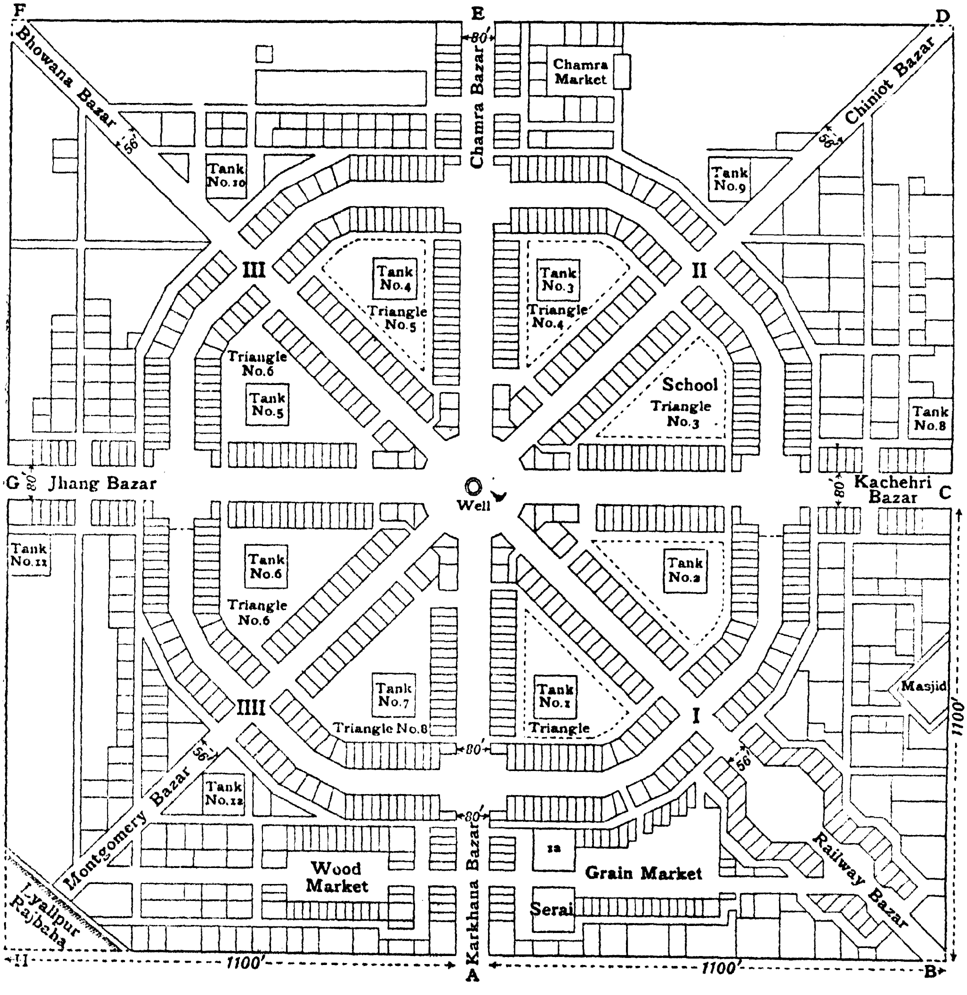
presents a striking and handsome appearance. The leases of the plots have fetched in most cases very good prices, and the State has provided liberally for the equipment of the towns with public works and for sanitary development by assigning for the purpose a sum equal to the proceeds of the sales for a considerable term of years. These assignments are generally placed at the disposal of the local governing body on conditions that ensure their disbursement only on the objects for which they are intended. The progress of

most of these towns has been strikingly rapid. I see that Lyallpur, which was founded in 1895, had in 1901 a population of over 10,000 people, and when I visited it about that time it was an exceedingly busy place with an enterprising and energetic population.

Agricultural Improvement.

Nor has the enterprise and energy which characterise the townsmen of the colonies been absent from the agricultural settlers. The opening up of new ground, under new conditions, has done much to shake the traditional conservatism of the Indian agriculturist, and this fact makes the new colonies the most hopeful fields for the improvement of agriculture by scientific methods. As the Government of India have now been able to set apart considerable sums for the promotion of agricultural education, and the organisation of thoroughly equipped agricultural departments all over the Indian Empire, the development of scientific work on practical lines should be most rapid in these new colonies. The Government of the Punjab has selected Lyallpur as the site for the new Agricultural College and Research Station now in course of erection, and a number of experimental farms have been established in all the canal colonies.

Fig. 4.



A large amount of preliminary work has been done. The economic conditions of the colonies themselves are favourable for the introduction of improved agricultural methods since the scarcity of field labour is forcing the farmers to look to labour-saving apparatus

as a way out of the difficulty. For instance, reaping machines are already in use in the Chenab colony for dealing with its enormous wheat crop, and in many other ways the agricultural industry is being improved under the direction of the State Departments of Agriculture. I shall give only two particular instances. On the Jamrao, Egyptian cotton has been successfully acclimatised. The lint produced has been pronounced to be equal to the best Egyptian product in fineness and length of staple, and has realised very remunerative prices. Last summer an area of 6,000 acres was sown by the more enterprising landholders, prominent among whom where the Panjabi settlers, and although just before the harvest the crop was almost completely ruined by boll-worm, what was saved was of fine quality and realised good prices. In the Chenab colony, important work has been done in the acclimatisation of both Egyptian and American cotton. Here again, repeated destructive attacks of boll-worm have prevented absolutely assured results being obtained. The Agricultural Department is very hopeful of devising some effective means of combating this destructive pest, and when this difficulty has been overcome, India will possess a splendid supply of fine long-stapled cotton, which cannot fail to have important effects on her own cotton manufacturing industry, and on that of this country.

Financial Results.

Before closing this paper, it may be of interest to notice briefly the financial results to Government of these great undertakings. Quite apart from the greater prosperity of the people actually settled in the colonies, from the increased food supply made available in an empire parts of which are frequently afflicted by serious failure of crops, and from any additional revenues which the State may gain from income tax and railway receipts, the net revenue due to irrigation on the Chenab in 1905-6 was £391,000, on the Jhelum £10,800, and on the Jamrao £39,300. The agricultural year for which these figures are compiled was a disastrous one in the Chenab colony, where the cotton crop was almost entirely destroyed by boll-worm, and extensive remissions of State demands were given. Taking the figures as they stand, however, they represent in the case of the Chenab Canal a return of 20 per cent., in the case of the Jhelum Canal of 1 per cent., and in the Jamrao Canal of 7 per cent. on the capital invested in the irrigation system of each. The poor financial result in the Jhelum colony is, of course, mainly due to the disastrous plague that overtook it in its early years, and to the fact that a large number of settlers are still receiving remissions. All three systems are capable of further development, and the net return to the State, which goes, it should be remembered, to lighten the burden of taxation in India generally, will rise with steady persistency.

In concluding this paper, I would like to remark that in writing it I have endeavoured to avoid controversial topics, purely technical matters and the expression of personal opinion. My aim has been to sketch in the broadest outline the work that has been done in the establishment of the great irrigation colonies in India. I venture to think that the account presents a piece of administrative achievement of the highest order, and I would remind you that the work has been accomplished by whole-hearted co-operation and devotion to duty, not only on the part of the Colonisation Officers and their staff, but also on the part of the Irrigation Officers and their establishment, and finally by the patient steady industry of the great mass of the Indian settlers.

DISCUSSION.

The CHAIRMAN, in opening the discussion, said it must be remembered in approaching such a topic that while they had undoubtedly in India achieved the greatest possible benefit to the population by the carrying of water to arid districts, they had not been the pioneers in the movement. Their more immediate predecessors, in the control of the greater part of India at any rate, the Mohammedan emperors, were from their earliest settlement in the country immensely interested in the irrigation of land; and he thought it was at least worth while recalling that, to whatever part of the world the Mohammedan race had carried its doctrines and its conquests, the one great feature of its system of administration had been the irrigation of the land over which Moslems had spread themselves. That was seen in Europe in those interesting and gigantic remains in the south of Spain; it was seen in many places in the north of Africa, and it could be seen, although in an imperfect state, in the east of Europe. It was quite true that while England had succeeded in developing the ideas which the Mohammedans initiated, we had not in this particular case of irrigating parts of India actually followed the lines which they drew up for their great canals and water schemes. The author, in the concluding portion of his paper, had drawn attention to the profits which had accrued to the

State as the result of successful experiments in India in irrigation, pointing out that the Government of India was the better off by half a million a year from the profits of the enterprises. It should, however, be mentioned that, although the enterprises in the Punjab were perhaps the greatest part of the undertakings on which the Government of India had embarked, they did not represent much more than one-third of the whole of the profits which accrued to the taxpayers of India from the money, industry, and skill which had been employed in irrigating the arid places all over the great continent of India. He had been particularly interested in the remarks the author had made with regard to the area which the Government of the Punjab allotted to each individual cultivator. Mr. Robertson had stated that 27 acres of land represented the amount upon which it might be assumed that an individual could live in comfort and decency according to the ideas of the country. An almost endless speculation might be embarked upon as to the amount of increase which was possible in the population of India if the whole of its sterile lands could be settled in the way the Punjab colonies had been; but it must be of the greatest importance to the State that the surplus population, which increased very rapidly in India, could be provided for by making provision, within the limits of the Indian Empire, for those people who were now crowding and overcrowding a great many districts. The second point which interested him greatly was that the author had mentioned the attention to sanitation which was becoming apparent in the villages. Nobody who was connected with the Government of India, either on the spot or at home, could have failed to be struck with horror and pity at the unceasing spread of plague in India. It had claimed nearly three-quarters of a million of victims this year already, and there was unfortunately a steady increase in the number of cases and of fatalities from year to year. He thought with only one exception the figure had grown steadily for about 10 years. All the efforts of the Government of India were devoted to grappling with that attack, but the greatest obstacles were the habits of the people themselves, and their failure to see the necessity of paying attention to sanitary matters. Until the prejudices of the population could be overcome, the ravages of plague could not be stayed; and, therefore, anything which pointed, in however small and tentative a fashion, to the understanding of the people themselves of the necessities of sanitation must be welcomed by all who were interested in the country. The author, perhaps wisely, had not dealt with the question of the incidence of the charge laid by the Government upon the cultivators for the benefits afforded. It was impossible to shut one's eyes to the fact that some, at all events, of the discontent which was reported as being prevalent in India at the present moment was connected with the assessments by the Government of the charges upon the land. Nothing would have interested him more than to have learned at first hand from one who was actually connected with the local administration of the colonies in what way and to what extent the charges were levied upon the colonists. It mattered little whether one turned to India and looked at the irrigation colonies, or to France and looked at the vine-producing districts, but wherever the cultivators of a country thought they were over-burdened with taxation in respect of the products of the land, discontent and irritation would be found; and it was to the advantage of the home Government and the Indian Government to inquire into and ascertain the causes of what might be called the unrest, and the measures which might reasonably and properly be taken to benefit the people who were cultivating the soil. He desired, in conclusion, to draw the attention of the public to the great task which the engineering staff of all kinds in India had undertaken on behalf of the Government. He could imagine no career more interesting for any young man—whether it was the most remunerative of all he did not know—than that of being a civil engineer in a great country like India. It was unquestionable that the British achievements which would be most deeply engraven in the soil of India were the railways and canals which had been created in that country, because means of communication and means of production were the essence of the life of the people of all countries.

Sir EVAN JAMES, K.C.I.E., C.S.I., remarked that it so happened that, while he was Commissioner in Sind, the Jamrao Canal was not only designed but carried out; and he had the pleasure of obtaining from the Government the services of Mr. Robertson as Colonisation Officer. India owed a great deal not only to Sir Dennis Fitzpatrick, to whose brilliant intellect and great common-sense the scheme for laying out of colonies was mainly due, but to the Colonisation Officers. The author would be the first to acknowledge his indebtedness to Major Popham Young, who was the first practical coloniser in India. The work done by the Colonisation Officers, of whom the author was one of the finest, was such as the audience could not possibly realise. For instance, in Sind the author was confronted with upwards of 1,000 square miles of absolutely waste country, and there was an old saying that there was only a sheet of brown paper between Sind and the infernal regions. Regardless of climate, Mr. Robertson had, with the aid of his Indian surveyors, surveyed the whole of that vast area, and divided it up into 1 acre patches. Every now and then a simoom occurred which obliterated the boundary marks traced on the ground, and the work had to be done over again. Mr. Robertson allowed nothing to discourage him, however, and the work had been carried out in the most admirable way. He laid stress on that point, because when he left India and went to East Africa he found a most terrible oversight had been made. Colonists had been invited to places very much resembling

Sind in their level character, with very little water, before marking out one single plot of ground, not even a farm or an area such as would be called a village or a parish in England. From that evil the author saved Sind as Major Popham Young saved the Punjab. Then the labour in choosing and settling the colonists needed untiring energy, patience, and tact. He desired to mention two points in the agreement with the colonists which he thought were of the most vital importance. One was that no settler, excepting the capitalist, was allowed to mortgage or alienate his land. During the last century all Indian officials had been impressed with the force of Arthur Young's magic of property maxim. Everybody thought the ryot would profit by being given absolute power and dominion over his land, but for the last forty years they had been trying to take it away again. Unfortunately the ryots did not know their own interests, and he supposed that in many parts of the Presidency of Bombay half or a third of the land which had been given to the ryots, on which they and their ancestors had lived for a couple of centuries, had passed from their hands owing to their want of intelligence and to the chicanery of moneylenders, as alien to the country as a Polish Jew would be in England. He remembered reading the Proceedings of the Duke of Richmond's Commission on Small Holdings in England, and some of the witnesses said that if small holdings were to be a success in England the power of alienation and mortgage ought not to be allowed. Various Commissioners suggested that that was a very strong measure, but experienced witnesses maintained that unless that system were adopted in England small holdings would be a failure. He was, therefore, glad to see that, in the proposals which were now before Parliament, small holders were not to have conferred upon them the fatal gift of power to mortgage and alienate. Another very excellent provision was that of preventing the holder absenting himself from his land; and to carry that provision into effect a man of very strong force of character like the author was needed. If there was the smallest reason to believe that an owner went away with the intention of living in his own comfortable home on the remittances which his agent obtained from tenants or sub-tenants, then the property was absolutely resumed. That might seem rather a harsh and arbitrary proceeding; but he asked the audience to consider what Canada, Australia, or the United States would have been like now if, when colonisation began, the colonists had not settled on the land, but had returned to England and allowed their agents to send them remittances obtained from mere labourers on the land. That was one of the greatest points in Sir Dennis Fitzpatrick's rules, which he was thankful to say had worked thoroughly well. With regard to what had been said about cotton experiments, he desired to say that the late Duke of Argyll, many years ago, sent some Scotch gardeners to parts of India for the purpose of trying to improve the cotton staple. After twenty-five years the experiments in Sind were abandoned because they had not been successful. Personally he should not like it to go out to the world that long staple cotton was going to be a success in India. Of course the boll-worm might be extinguished, but his impression was that certain products suited certain countries, and that they must not depend, any more than they did in 1864-5, on getting the best cotton from India. He ventured to think that few more interesting papers had been contributed to the Society of Arts than that read by Mr. Robertson.

Sir FREDERIC S. P. LELY, K.C.I.E., C.S.I., imagined that very few present would have suspected, if it had not been disclosed by Sir Evan James, that the author of the admirable paper had been himself a most efficient and successful colonization officer, so great had been his modesty. What Mr. Robertson had said with regard to laying out a village reminded him of an experience of his own many years ago in the district of Ahmadabad, where a flood had carried away ten or twelve villages. He was entrusted with the work of rebuilding them on new sites, and remembered sitting down and evolving out of his own head what, in his youthful complacence, he thought a most admirable plan adapted to meet every requirement. He sent the plan the next day to be carried out, and subsequently was taken aback by a crowd of the villagers coming and casting it at his feet and saying it would not do at all. They pointed out that a good many of the houses were projected to face the East, and although they did not say so in so many words they pretty clearly intimated that he was an exceedingly simple person not to know that in that quarter there dwelt a demon, who would most certainly enter their houses and give them no end of trouble if doors and windows were placed in that direction giving him ingress. Although the laying down of a village did not seem to be a very complicated matter as shown on the screen, it presented far more difficulties than appeared at first sight. He thought all would agree that the description of the work given by the author presented a signal example of how much work was to be done in India, and how the work which sank deepest into the life of the country was that done face to face with the people. The native of India did not care much for principles or political theories; in fact he did not know anything of them. What he wanted was moderate taxation, freedom from harassment, and his own institutions, or at any rate the spirit of them, and under or over them all a sympathetic officer who understood him. He desired most heartily to endorse Sir Evan James's remarks with regard to the land tenure question. He was very pleased to see that an untrammelled experiment was going to be tried of giving the people absolute possession of their land, but at the same time preventing them playing ducks and drakes with it. Indian officials had been

a very long time in coming to see that the absolute ownership of the land and the absolute power to transfer had been a burden to the people of India too great to be borne; it merely made them the victims of money lenders. He did not desire to say a word against money lenders, but when such people saw the land in the hands of people who were only too willing to part with it for a mess of pottage, they naturally tried to get it for themselves, and that had been in the main the reason of the indebtedness of the people of the country of which so much was heard. They had lately been told in *The Times* that the very colonies which, to their minds, were triumphs of the British engineer and administrator, had been made the handles of sedition and discontent. He did not know enough of the circumstances to be able to suggest how that arose, but if the author could explain the position to them he thought all present would be grateful.

Mr. H. S. LAWRENCE, I.C.S. (Director of Agriculture, Bombay), remarked that the author had very wisely avoided all controversial topics, but he would not follow Mr. Robertson's example, his object being to gain knowledge on certain debated matters. The first point to which he desired to allude was a very important matter regarding the future development of the canals, which was a subject of discussion amongst experts in India, and on which they would be very glad of any light which the members of the Society might be able to throw. The question was, What was the effect of irrigation on alkali soils? The alluvial deposits of the rivers from which these canals were derived contained large tracts of alkali, and, on the one hand, it was alleged by agricultural scientists that the effect of the advent of a permanent irrigational canal would be to draw the alkali from the sub-soil to the surface, and to render large areas infertile. On the other hand, the irrigational officers of the Punjab stated that their experience was directly the contrary—that the alkali was driven down by ample irrigation, and could be washed out of the soil entirely. That point required investigation, because as yet no competent agricultural observers had had time to consider it thoroughly; but as regards the province of Sind, the Bombay Government were anxious that it should be fully examined. Fortunately they had secured the services of a most eminent scientific officer, Dr. Mann, than whom nobody could be more competent to advise them in this task. He had been interested in the author's reference to the agricultural improvements which were in prospect in the colonies. Those improvements chiefly turned on the novel character of the irrigation which was provided by the perennial canals. In Sind, and, he believed, in the whole of the Western Punjab, all the old canals were inundation canals; and in Sind at present 90 per cent. of the cultivation was dependent on inundation canals, *i.e.*, water was only available while the snows were melting in the Himalayas and the rivers were in flood, from the months of May to November. So brief an agricultural season necessarily ruled out of the agricultural programme all such valuable crops as wheat, sugar cane, oil seeds, long staple cotton, and spices, which either required a longer period of growth or else a more temperate climate in the winter. But the perennial canals had entirely revolutionised the agricultural system. It would take time for the colonists to change their ideas and to learn the most efficient management of land and water in those new conditions, but the great growth of wheat exports from India of recent years was largely due to the irrigation colonies, and there was no doubt that their present prosperity was only the early promise of what was to come. In passing, he desired to allude to the important projects which were now under consideration for the construction of barrages on the Indus similar to those which had been constructed on the Nile. Those barrages, if they could be constructed—and engineering opinion was very hopeful on the point—would have the effect of adding six million cultivated acres in Sind alone, and would also convert all the existing inundation canals in Sind into perennial canals. The effect on the increase of valuable crops in Sind would be enormous. The author had stated that the exported produce of the Chenab colony in one year amounted to 2¾ millions sterling, and that the net irrigational revenue was less than £400,000. It would be interesting to learn, in view of the recent experience to which the Chairman had alluded, exactly what was the proportion of the total payments of the colonists to the value of the produce reported. So far as he was able to ascertain, it was something less than 20 per cent.; and it was possible that, as was the practice in most parts of India, the cultivators reserved their food supply for themselves first and exported only the surplus. At a time when projects for securing a greater measure of control over land were before the public, it was interesting to reflect upon the position of the Government of India as illustrated by the irrigation colonies. That Government might be described as a Radical autocracy. It was often denounced as an autocracy, but its Radical and Socialistic qualities were seldom recognised. In the case under discussion a good example of that was seen. The State was the absolute owner of vast tracks of sterile desert, and, by utilising the mighty reservoir of the Himalayan snows, transformed that desert into a smiling, fertile cornfield. Great benefits were conferred on the cultivators, and a share of that produce, very far below an economic rent, was taken from them, and went to lighten the general burden of taxation in India. These principles were identical with those which governed the action of the State in all departments in India, though one did not often see so clear an example of the assertion of the right of the community to a full share in the surplus values created by the community. But it was a curious phenomenon to observe, that amongst the gentlemen who advocated those principles for adoption in home

politics some were to be found who cast at the Government of India in such matters the most vigorous and hostile criticism. Some gentlemen who anathematised the principle of private ownership of land in England supported movements in India, the object of which was to restrict the rights of the State over land. Again, men who strenuously opposed the domination of propertied and landed interests in England could be found working, no doubt unconsciously, to hinder and obstruct that Government in their efforts to protect the peasant and the labourer from oppression and spoliation. It would be well if those gentlemen, who understood so little the application of their principles to India, could be induced to study the history of the irrigation colonies, when they would be surprised to find that the very objects which were aimed at by advanced schools of thought in this country were already, to a great extent, secured by the land systems of India. No doubt mistakes had been made in the grant of excessive power over the land to people who were not prepared to utilise it to the best; but, taken on the whole, those systems gave to the people the magic right of property which converted sand into gold, and at the same time had been successful in safe-guarding for the State the communal rights to increments of value.

Mr. J. S. Beresford, C.I.E., M.Inst.C.E., remarked that there appeared to be considerable misapprehension regarding the Square Survey, which in the Punjab was entirely the work of the Irrigation Department, carried out before the Colonisation Officer had been appointed. It formed the basis of the large contour maps of the tract, as explained in Mr. Sidney Preston's paper of 1902. The Colonisation Officer afterwards had the original squares sub-divided by parallel ridges into plots or fields of about one acre, an important work in itself and one difficult to carry through in practice owing to the colonists usually making the ridges crooked. Referring to the produce obtained from the irrigated land, he remembered in 1897 having experiments made with regard to the produce in the Chenab colony, where the finest wheat crops he had ever seen were then grown. Eighty bushels an acre in some cases were produced. It had been said in the paper that long staple cotton had been grown in Sind and the Chenab colony, but nothing had been mentioned of the produce, upon which everything depended. In Egypt the average produce from an acre was 600 lbs. of ginned cotton, worth from £15 to £20, but he understood the produce in the irrigation colonies in India was probably only a quarter of that amount at present. Compared with Egypt, with which he had had an intimate connection since he retired from the Indian service, the produce of cereal crops in the Chenab colony was better than that of Egypt, and there the rents varied from £6 to £9 an acre, while £4 an acre was being given for one crop of wheat in a large area which had been recently brought under cultivation; it was very hard to understand why complaint should have been made of excessive taxation in tracts irrigated by perennial canals when one remembered the very low rates that existed in India. He had spoken to settlement officers who had been in Egypt, and they were much puzzled with the comparison. No mention had been made in the paper of the railways that had been constructed, without which it would not have been possible to carry away the products. Referring to the question of sanitation and wells, the first difficulty was to get wells in which the water was drinkable. When Lord Curzon visited the colony in 1899, at Lyallpur, the large central well was one of the show places of the town, but the fresh water being pumped from the well was supplied from a canal channel. The well water, generally, was of a brackish nature, although he believed its quality had improved since those days. The wells were then 100 feet deep, but owing to percolation from the canal they had now probably risen and become sweet. The question of the deposit of salt was dealt with largely in Egypt, there being vast areas which had been reclaimed by washing. In one big scheme, in an elevated tract, the reclamation was effected by washing downwards, by flooding the surface to a depth of three feet. It was found that all the deleterious salts were carried down, and all the soluble nitrates as well, and before a crop could be grown £1 an acre had to be spent in the provision of nitrate of soda and sulphate of ammonia. That, as far as he understood, was a process which was never adopted in India. In Egypt, no one expected continuous good crops without spending annually a pound or two an acre on artificial or other manure. He did not suppose, however, that the people in India could afford it at present, but if they obtained the land and water free for two years, as a start, they might be able to do so. The use of artificial manure was one of the questions which must be carefully looked into in the future. One point the author had overlooked was that it was difficult to separate the Colonisation Department from the Irrigation Department. When he was connected with the Chenab colony, there was only one Colonisation Officer and his native assistants, while at the same time there was a Superintending Engineer, and five Executive Engineers, with their complement of Assistant Engineers, five Deputy Collectors and a large subordinate staff, all engaged on maintenance of works, and on irrigation in the fields. It was essential that a large staff of trained engineers should be employed, and on the efficiency of that staff, on the careful distribution of the water, and on the general administration of the irrigation, the success of the scheme depended. Having regard to these facts he thought a stronger term than co-operation might have been used by the author respecting the work done. The Public Works Department

would highly appreciate the tribute paid by the Chairman to the Engineering staff.

Mr. R. B. BUCKLEY, C.S.I., M.Inst.C.E., in reference to the question of the present unrest in India being in any way due to the imposition of water rates, said he could not speak personally with reference to the irrigation colonies of the Punjab. He could, however, speak with very intimate knowledge indeed of a large system of irrigation in another part of India, where for several years he had to deal with troublesome questions something of the same nature as those which arose at present, where those who drew their supplies of water from the canals were constantly saying that their water rates were too high, and that they were being ruined. That system at one time did not use all its supply of water for irrigation purposes. Now, he believed he was right in saying that every year irrigation leases were refused to thousands of acres because there was not sufficient water to supply the demand. The people complained that their water rates were too high. The Government had raised the rates wisely but gradually, and he fully believed the people could easily pay double the rates they were paying at present. The cultivators took water for every acre for which it could be obtained; they clamoured for leases, and it was a remarkable fact that, although on that canal 250,000 individual cultivators were dealt with, and the water rates were collected from them individually, for the last four or five years there had not been one single rupee which was not paid at the date it became due. People who were complaining that they were being burdened with rates would not pay them so willingly if the price was higher than they could afford to pay. He, therefore, did not think much reliance could be placed on the complaint that the unrest was due to excessive water rates. It was difficult to appreciate the dimensions of the works which had been described in the paper. The author had stated that the three schemes in the Punjab commanded some 8,500 square miles, about 6,500,000 acres. That land had been entirely reclaimed from the desert; it was a new country with a new population, and the area was just about the same as the culturable area of Egypt. Administrators and engineers had created in India a new country as large as it had taken thousands of years of irrigation to make in Egypt. He thought the people of this country did not altogether appreciate the size of the canals. If the old records of Babylon were inspected it would be found that one of the monarchs described, in a cuneiform inscription which he placed some 2,500 B.C. on one of the monuments in Chaldea, how he had created a great irrigation colony there, 250 miles long, and 20 miles broad, or 5,000 square miles of country; he created, so he said, great rivers in the desert. The Chenab Canal was a great river in the desert. A great many people in this country formed their idea of irrigation canals from the canals they saw when travelling down the Great Western Railway, or in Regent's-park. Some of those present had no doubt stood on Staines bridge or Richmond bridge, and seen the Thames in flood, the waters spreading over the country on every side. tearing through the arches of the bridges, and flowing over the tow-paths. The Chenab Canal, at certain times in the year, carried about the same quantity of water as the Thames in flood. The men who had made those works had done well for India. The king who created great works in Babylon said at the end of his inscription, "I have given them fertility and plenty, and have made their homes the abode of happiness." The men who had made and administered the great works in India had done the same thing for hundreds and thousands of people who, but for these works, would have been poor and perhaps in want.

Colonel Sir COLIN SCOTT-MONCRIEFF, K.C.S.I., K.C.M.G., R.E., remarked that it was 48 years since he tried his 'prentice hands on the canals of India; it was 24 years since he finished with India, and 15 years since he left Egypt. Others who came after him narrated what was going on at present, and he could only read their reports and rejoice in their doings. In the early days, irrigation people were looked upon rather as faddists, and great doubts were expressed whether irrigation would do any good. Some people said it increased the fever and brought up the salts in the soil, but there were always a few staunch men who contended that the work must be a success. Such an idea as an irrigation colony was not then thought of; and it was a great pleasure to him, when he visited India six years ago, to see Lyallpur, an Eastern town that had been deliberately set out on sanitary principles. Probably his hearers were unaware of the fact that the centre of the town was planned upon the form of a Union Jack, in exactly the same way as Lord Kitchener had planned Khartoum. The Chairman had alluded to the fact that the Mohammedan wherever he went turned his attention to water, and that was quite true; he had found the same irrigation terms in use in the south of Spain as he knew in the north of India. He thought, however, he was right in saying that the engineering problems placed before the Mohammedan Emperor in Northern India were too great for him, because in the canals which he dug from the Ravi and the Jumna the slope of the country was so great that they became ravines, and they had to be given up. The British Government he thought, therefore, might fairly claim to be the author of those canals. The Punjab was the finest field possible for the use of such canals, and it was impossible to expect that a field equal to it would be found in any other province of India. Irrigation works established in Bombay and Madras must be much more costly, and the results must be much smaller than those in the Punjab. One of the speakers had made a most truthful remark when he stated how much depended upon the sympathy of the

canal and revenue officers. When he first went to Egypt he was fortunate enough to get a most valuable party of officers to follow him from India. They were just beginning to speak Arabic after a year's residence in the country, when complaints began to reach him of oppression in the Irrigation Department, and he told the natives that he would send a native commissioner to inquire into them. They instantly replied, "No, no, for goodness sake do not send him; send one of the new Englishmen." He remembered that on one occasion one of his "new Englishmen," a very brilliant fellow, was riding through a village and was greeted by the not uncommon cry, "There goes a Christian dog," when one of the natives, who knew of his work in the Irrigation Department, said, "No, that man is not a Christian, he is an Englishman." He believed it was that sympathy, apart from his high technical skill, which made the irrigation officer a success. In India they soon found out the difference between the man who looked on his work as an end, and on the man who looked upon the work as a means to an end; and it was the latter kind of man that they always tried to select for the charge of the running water, and for settling the little disputes between man and man.

Mr. T. W. HOLDERNESS, C.S.I., desired, in the first place, to refer to the paradox that the colonists who had been benefited so largely by the canals appeared to be discontented, and, as he gathered from some of the speakers, they were under the impression that the cause of the discontent was the enhancement of the land and water rates. So far as he had studied the question, he thought that was not at all the case. The cause of the discontent was the Colonisation Bill, which the Viceroy had now withdrawn, That Bill did not contain a single clause which had any reference to taxation; it was a Bill for settling certain administrative questions in the colony, regulating successions, imposing sanitary obligations and other things, and to a certain extent it did have restrictive effects with regard to the conditions of the grants. As far as he could make out, the Bill in many respects had been misunderstood by the colonists, and its effect very much exaggerated, and he had no doubt that after a calm season of reflection the people would understand that their fears were unfounded, and would see the necessity for some moderate measure of the kind. The second observation he desired to make was with regard to the continued fertility of the lands. The produce had been very great because water had been applied to virgin soil; but he believed there were signs that the produce was now gradually falling off, and it was a question whether the present great prosperity would continue. That was one of the great problems before the Agricultural Department of India; it was very essential that they should continue to make a very careful study of it, and, if possible, to check both waste of water and exhausting cultivation without manure.

Mr. T. H. THORNTON, C.S.I., D.C.L., said that, having been for many years connected with the Punjab Administration, he desired to ask whether any provision had been made in the Punjab colonies for the systematic planting and conservation of trees. In the first place, trees were very valuable for supplying agricultural implements; and, secondly, it had been found by experience in other parts of the Punjab that belts of trees round villages were very useful in checking the spread of disease. It was quite possible that that work had been done in the Punjab, but no mention was made of it by the author. He desired also to ask whether it had been ascertained that the founding of the villages had led to a great increase of malaria, and if so whether any special measures had been taken for checking its progress.

Mr. ROBERTSON, in reply, thanked the audience very much for the kind manner in which his paper had been received, and the speakers for the kind way in which they had commented on it. Mr. Holderness had shown that the so-called unrest in the Chenab colony was connected, not so much with the taxation of the landholders, as with an agitation which had been got up against a Colonisation Bill. He (Mr. Robertson) thought that burden of proof was on the man who asserted that the taxation of the colonies had been excessive, because the facts were against him, such, for instance as, the prosperity of the people, and that for every acre offered there were thousands of applicants, who were willing to pay the present taxation. In reply to Mr. Thornton, he would like to say that, from the very first, the colonisation officers everywhere had encouraged the planting of trees; and one of the provisions of the Bill to which Mr. Holderness had referred would make it incumbent upon each grantee to plant a certain number of trees throughout the country. He had never heard any scientific explanation of the fact that, when ground unploughed for centuries came into cultivation with the aid of irrigation, the cultivators themselves were certain to get malaria, but in a year or two the virulence of the disease seemed to pass off. The Government did everything to mitigate the evil, by such measures as making available to the very poorest quinine in large quantities at every post office in India. With reference to Mr. Beresford's remarks on the subject of the co-operation of the Irrigation Department, he had no wish whatever in his paper to leave the impression that every man connected with the colonies did not fully appreciate the work which had been done by the engineers, not only in the construction of the canals, but in the distribution of the water and in assisting in every way the cultivators to prosper; indeed, without the engineer there would have been no colonisation officer. The engineer was the first on the ground, and it was only with his co-operation that the colonisation officer could make any progress at all.

The CHAIRMAN, in proposing a very cordial vote of thanks to the author for the paper he had read, remarked that personally he felt very much indebted to Mr. Robertson for the information he had given upon a most interesting subject, while the discussion which had taken place had not been the least important part of the day's proceedings.

The resolution of thanks was put and carried unanimously.

SIR THOMAS HIGHAM, K.C.I.E., M.Inst.C.E., writes:—

Mr. Robertson's paper gives a very interesting account of a very interesting subject, and by a happy thought the writer has placed side by side the leading features in three distinct colonising operations, one of which was carried out at a great distance from the other two, and under a different Administration. It may be noted, however, that the earliest irrigation colonies were not those established on the Chenab. In 1886 colonisation operations were started in the Multan and Montgomery districts in connection with the settlement of about 206,000 and 91,000 acres of waste lands to which irrigation was to be extended from the Sidhnai and the Lower Sohag and Para canals, then under construction in these districts. The operations were carried out by the Deputy Commissioners of the two districts, working on lines which had been laid down by the Financial Commissioner, the late Colonel Wace, who took the strongest personal interest in the matter, and from the first realised the immense importance of these pioneer experiments as a guide for the conduct of the future settlement of the millions of acres of Crown waste on the Chenab and elsewhere, to which the extension of irrigation was known to be feasible, and was then under serious consideration. The plan of operations subsequently adopted on the Chenab was based on the same general lines, but there were, of course, several important modifications in details. Of these it is sufficient to mention the reduction in the size of the peasant allotments. The "unit square" was the same on the Lower Sohag and Chenab canals, 27·7 acres, the side of each square being 1,100 feet, but on the former the peasant generally received 4 squares, or about 111 acres, whereas on the latter he received but a single square. On the Sidhnai, owing to a difference in the local measures, a somewhat smaller unit was adopted, and the average area of the holdings was about 80 acres. These were found in practice to be much too large, and it was decided to limit the peasant allotments on the Chenab to a single square. The much smaller unit subsequently adopted on the Jamrao suggests that the Chenab and Jhelum units are not too small, although many circumstances must affect the comparison. The Sidhnai and Lower Sohag were the first sanctioned projects which involved the extension of irrigation into uninhabited waste lands, even on a modest scale. Up to 1889 the objection had been urged against all large schemes for the irrigation of desert and uninhabited tracts that the development of irrigation would necessarily be so slow that more than a generation must elapse before the net revenue would suffice to meet even the interest charges. There was some foundation for this view in the slow rate of development on existing canals constructed in well populated tracts. The first tentative efforts in colonization on the Sidhnai and Lower Sohag were, however, encouraging, and the subsequent success attained on the Chenab, Jhelum, and Jamrao has clearly demonstrated that as soon as the engineers can deliver a regular supply of water on good cultivable soil there is not likely to be any difficulty in at once attracting as many cultivators as required, if colonization operations are undertaken on the lines which have now been approved by this extended experience. The development of irrigation has indeed been much more rapid in the new colonies than it has ever been in old and established villages on the older canals, or in those on the Chenab Canal itself. The reason is not far to seek. The old proprietors cannot as a class readily adopt themselves to new conditions: they are wanting in enterprise and generally destitute of capital, and are unable or unwilling to offer sufficiently attractive terms to cultivators; whereas in the new colonies every cultivator has a holding of his own, and has the strongest inducement to exert himself to the utmost in the development of his grant.

From an economical point of view the most interesting feature in the leases is the condition in the peasants', and latterly in the yeomen's grants, that the permanent and hereditable right of occupancy in the holding is unalienable either by gift, sale, will, or mortgage. One would like to know how this important provision has worked in practice; whether it is open to all the objections of the *laissez faire* order which were at one time urged against it, or whether it seems likely to secure all the objects which were aimed at when it was introduced. It is perhaps too early for a confident opinion on the results of this new departure, but some of the Chenab leases have been running for fourteen years, or more, and it would be interesting to know whether the experience so far gained of the effect of this provision has been favourable or the reverse.

The railway branches referred to in the paper must have been an indispensable factor of the success attained. In 1894 it was realised that the Chenab colonies would be a failure if a railway were not immediately provided. The 200 miles required formed no part of the current railway programme, but fortunately the Government of India recognised the urgency, and the northern half of the line was opened in the following year. Its success was immediate and surpassed all expectations. Not only was the stability of the colonies assured, but also the line became, as soon as completed, one of the most remunerative sections of the North-Western Railway. After this experience there was no hesi-

tation or delay in constructing the branches subsequently required for the Jhelum tract. Light feeder railways would also be of great service. I agree with the writer that they are likely to prove very remunerative, and when once a start has been made there can be little doubt that many miles of such lines will be speedily brought into operation.

STATISTICS OF NEW ZEALAND FOR 1905.*

Population.—The total estimated population (exclusive of Maoris, &c.) on December 31st, 1905, consisted of 882,462 persons, being an increase during the year of 24,923, made up of 15,621 excess of births over deaths, and 9,302 excess of immigrants over emigrants. Of the total population, exclusive of Maoris, 496,847 are males and 441,050 females.

Vital Statistics.—Several pages are devoted to returns as to the number of marriages, deaths at various ages, cause of death (it may be mentioned that the deaths from phthisis, which numbered 496, were the lowest during the decade), occupations and age at death of males, mental hospitals, benevolent and orphan asylums, as well as industrial schools. Meteorological information under 46 headings is reported for each month of the year from 12 stations.

Shipping.—The returns under this heading cover the number, tonnage, crews, cargoes, and inwards and outwards from each port, with the country of origin or destination. Out of a total tonnage of 1,139,410 entered, 462,850 tons were British owned, 500,467 tons owned by other colonies, and 176,092 foreign owned. The number of New Zealand vessels upon the register is 609, having a gross tonnage of 171,753, and a net tonnage of 119,119 tons.

Imports.—Upwards of 95 pages are devoted to itemized details of the import trade, setting out for each item the total quantitity imported, rate of duty per unit, value of total imports, together with amounts of duty under preferential or general tariff rates. Obviously only a few important items can be mentioned. At the outset one notices the ready-made clothing trade in apparel and slops, aggregating £613,600 in value, and subject to a general tariff duty of 25 per cent. Of this trade £565,588 comes from the United Kingdom. Books enter duty free; the total value was £183,600, of which £136,224 came from the United Kingdom. Boots and shoes pay 22½ per cent. *ad valorem* under the general tariff, with an additional 11¼ per cent. *ad valorem* under the preferential tariff.† The total value imported was £263,523, of which £174,006 came from the United Kingdom, under the general tariff, and £5,313 under the additional preferential rate. Coal, which is duty free, came mainly from New South Wales, which sent 168,757 tons, valued at £155,475, out of the total importation of £169,046 tons. Drapery, subject to a 20 per cent. *ad valorem* duty, amounted in value to £274,020, of which £259,527 came from the United Kingdom. Hardware, hollow ware, and ironmongery, amounted in value to £259,830, of which £195,388 came from the United Kingdom, under the general tariff. Bar, bolt, and rod iron was valued at £129,166; the United Kingdom supplied £123,189 under the general tariff. This proportion is not quite so good in regard to pipes and fittings, of which £99,892 were imported, and rails, total value £102,672, but about 87 per cent. of these articles are British made. The galvanized iron trade is entirely British, £223,074 coming from the United Kingdom, out of £223,135 value imported.

In regard to agricultural machinery, which is duty free, the United Kingdom only supplied £26,055 out of £100,423, the United States supplying £53,479 worth. Electric machinery for general purchasers was imported to a value of £115,557: of this £54,352 came from the United Kingdom, and £46,311 from the United States. There was also imported for Government use electric machinery valued at £42,865, of which £35,776 came from the United Kingdom. There was a good demand for gas and oil engines, the total value amounting to £68,130, of which £40,619 value was British made. Mining machinery, which was duty free, amounted in value to £36,919, of which £29,806 came from the United Kingdom. Woollen piece goods were valued at £406,546, of which £381,071 value came from the United Kingdom. There is no additional tariff upon woollen piece goods made outside the Empire.

The total value of the imports of New Zealand during 1905 was £12,828,857, of which only £599,764 was subject to extra preferential duties. The total nett duty received therefore under the Customs tariff was £2,652,666, of which £64,377 represented sums collected in the shape of extra duties.

Exports.—The figures relating to specific items of export trade describe whether made within or without the colony, and values in each case. The total values of the exports to New Zealand during 1905 amounted to £15,655,947, of which £15,503,530 represents the produce and manufactures of the colony. Of this total no less than £12,087,818 went to the United Kingdom, while France received £48,963, Germany £38,958, and the United States £716,301. The Australian Commonwealth received exports valued at £2,268,373. As regards the component items of export trade, the following figures are of interest:—Gold, £2,098,936; timber, £891,410; butter, £1,408,557; meat (frozen), £2,694,432; wool, £5,381,333; wheat, £144,374; and leather manufactures, £696,467.

Wages.—The average rates of wages are set out for nine districts for several occupations. Space only permits a few quotations, extreme ranges being

* Abstracted from the official returns, compiled in the Registrar-General's Office, and printed by John Mackay, Government Printer, Wellington, 1906. Two vols., 652 pp.

† It should be noted that under the New Zealand Preferential and Reciprocal Trade Act of 1903, certain articles *not* being the produce or manufacture of some part of the British Dominions, become subject to additional taxation.

given:—Farm labourers, without board, 5s. to 8s. per day, with board, 17s. 6d. to 25s. per week; shepherds, with board, per annum, £52 to £80; masons, per day, without board, 10s. to 14s.; bricklayers, per day, without board, 10s. to 14s.; smiths, per day, without board, 8s. 6d. to 12s.; cooks, with board, per week, 15s. to 30s.; general servants, with board, per week, 10s. to 17s. 6d.; general labourers, without board, per day, 7s. to 10s.; shop assistants, without board, per week, 30s. to 60s.

Railways.—The total mileage of line open for traffic on March 31st, 1906, was 2,407. The cost up to that date was £22,498,972. The gross revenue was £2,349,704. Working expenditure absorbed 69 per cent. of the receipts, leaving a net revenue of £728,465, which is equal to £3 4s. 9d. per cent. of earned interest.

Production.—The pages relating to production cover such items as increase of live stock, numbers of flock owners, acreage of crops, numbers of factories (with details as to number of workpeople, value of materials produced, and value of site, buildings, machinery, and plant). So far as factories are concerned, these returns relate only to the industrial census of 1900.

As regards the total live stock, the following are the figures for 1905-6: horses, 326,537; cattle, 1,810,936; sheep, 19,130,875; and pigs, 249,727.

The coal raised within the colony was 1,585,756 tons, being an increase of 47,918 tons over the preceding year. The total value of the gold and silver produced was £2,224,478, of which the silver was valued at as £120,542. The total number employed in the gold mines in 1905 was 9,362, of whom 803 were Chinese occupied in alluvial work.

Education.—A return giving the ages of scholars attending public schools shows that out of a total of 137,623 scholars only 2,586 are over 15 years of age; of other ages there are between 14 and 15, 5,414, between 13 and 14, 11,423; between 12 and 13, 14,579; and between 11 and 12, 15,453. The subjects of instruction in the primary sechools embrace English, arithmetic, drawing, singing, physical instruction, geography, history, nature study and elementary science, handiwork and needlework. Figures are given of the number of scholars returned as learning each subject. Thus 52,777 out of 65,673 girls receive instruction in needlework. History seems the most neglected study, only 59,956 scholars attending these classes. Geography is more highly regarded, 79,981 being the number reported. Handiwork is taught to 93,565 scholars. All other subjects are taught to 122,000 or more children in these schools. Government grants provide £641,025, and local sources £8,697 for expenditure on these primary schools.

Secondary or superior schools are attended by 2,467 boys and 1,593 girls. The total expenditure on secondary schools in 1905 was £88,191, towards which fees produced £29,575, Government grants, £14,137, and endowments £35,627.

The New Zealand University had upon its rolls on June 1st, 1906, 807 male and 532 female nudergraduates in the faculties of arts, science, law, and music, and 117 male and 32 female undergraduates in the faculty of medicine.

Other educational returns relate to private or denominational schools and schools for Maoris.

Other Statistics.—Such matters as postal and telegraph finances, law and crime, and local government statistics of boroughs, counties, &c., do not call for comment in these pages.

JAPAN AND THE CHINESE COTTON MARKETS.

Persistent efforts are being made by Japanese merchants, with the aid of the Government, to capture the cotton markets of China, and with this object in view, the Japanese mills have, during the last six months, increased the number of their spindles. Evidence is not wanting that the Japanese Government is looking with favour upon, and lending financial assistance to, the development of the cotton industry. Japan has many things in her favour in this struggle for the Chinese cotton market. She has an abundance of cheap, concentrated labour, she understands the wants of the Chinese people, and is in a better position geographically to meet the demand, than any other country. China is producing large quantities of cotton, but the quality is not good, and has to be mixed with either American or Indian cotton to produce good fabrics. Japan uses large quantities of Chinese cotton in the manufacture of textiles, and will no doubt seek control of the supply. She is even now, it is said, growing cotton of her own, in order to make herself independent of the foreign supply. It is interesting in this connection to note the sources from which Japan obtains her raw cotton. From reliable statistics for the half-year ended June 30th, 1906, it is shown that the cotton mills of Japan used 209,574,662 pounds of raw cotton. Of this amount India supplied the greatest quantity, 75,673,683 pounds; China 67,996,954 pounds; and America 58,541,589 pounds. From all other sources only 7,362,436 pounds were used. With three exceptions all the mills in Japan used American cotton. Five mills did not use Indian cotton at all, and five did without any of the Chinese product. The total number of spindles in operation in the cotton mills of Japan last July amounted to 1,371,730, and the cotton consumed that month amounted to 35,814,125 pounds. These figures evidence the rapid strides the cotton industry is making in Japan. Nearly every mill increased its spindles and enlarged its capital stock, and every mill showed a satisfactory financial condition. There has been under consideration the question of building a cotton mill in Dalny, but conditions for several years to come will not warrant the outlay. The cost of living is double what it is in Japan, and there is a scarcity of labour which would make such an institution almost impossible to work at a profit.

HOME INDUSTRIES.

Illegitimate Industries.—A report of the Medical Officer of the Port of Manchester reminds one of what may be called the illegitimate industries that thrive in connection with food imports. The food stuffs brought into the port of Manchester last month were in excellent condition with the exception of a small percentage of grain damaged through contamination with bilge water, or from contact with the moisture condensing on the iron sides of the vessel. This contamination gave rise to fermentation, with the creation of considerable heat, and produced a mass of material upon which moulds and bacteria throve vigorously. Samples of damaged wheat and maize were sent to the Public Health Laboratory for examination, and the result showed that each sample contained moulds. The danger from consumption of these materials is the presence of bacili of the coli type; the unknown dangers cannot be gauged. But this poisonous stuff has a ready sale. It is used for the feeding of pigs, and the making up of poultry food, and is also used in the manufacture of articles intended for human consumption, especially cheap whisky and glucose. Dr. Dearden states in his report that he had made a hard and fast regulation not to deliver such grain to any person except a purchaser who would himself utilise it for purposes other than human food, and then only on an undertaking to allow an inspector of the Authority to visit the place of utilisation and satisfy himself as to the genuineness of the guarantee. But it is to be feared that medical officers are not always so alive to their responsibilities, and that despite all the precautions taken much poisonous stuff is used in the preparation of human foods. Between April 29 and May 26 the amount of food stuffs condemned at the foreign animals wharf, Manchester, and the docks, weighed 14 tons 16 cwt. 1 quarter 27½ lb., and included wheat which was delivered to the owners for making poultry food and cornflour, and which was allowed to go for the purpose of "size" making. It appears that the Authority has at present no legal power to prohibit the sale of foodstuffs which are not intended directly for human consumption. If the inspecting officer is satisfied that the unsound wheat is not to be used directly as human food he cannot prevent its leaving the docks to be used for, say, poultry feeding. The law would seem to need strengthening in this respect, and the public health to require that foodstuffs in a rotten condition when they reach British ports shall be destroyed forthwith.

The Cotton Position.—The report of the American Census Bureau upon the cotton crop confirms the general impression as to the present outlook. The estimate of condition is 70·5 as against 84·6 last year. The necessity for replanting has made the crop a late one. A great amount of seed was killed by the cold, wet weather, and the planters have had difficulty in replacing it; those who had planted "bender" seed have now had to be satisfied with seed of a poor grade; and a good deal of the seed used has been found infertile. As to acreage, the estimate is 36,060,000 against 28,686,000 last year, but last year's estimate was not generally accepted. Last month was the smallest turnover in piece goods in the cotton trade in Lancashire for some years. There has been no stimulating influence from abroad to encourage exporters to operate. Cotton continues high, and yarn remains dear. Meantime cotton mill construction proceeds, notwithstanding the increased cost of machinery, understood to be close upon 20 per cent. dearer than eighteen months ago. A new spinning mill is about to be erected at Bolton, another at Chorley, and two at Oldham, in all 450,000 spindles, costing £600,000. And some of the new concerns that have been working only six months or so are about to erect No. 2 mills.

The Coal Trade.—Now that many of the annual coal contracts have been arranged, the extent of the advance which has been made by the coal trade of the country during the year may, to some extent, be gauged. An average increase of 3s. per ton has been established in gas coal for contracts over the next twelve months. Steam coal shows an even higher advance, best large Welsh coal being fully 4s. dearer than a year ago, whilst the renewal of London house coal contracts is based on an advance of 2s. 6d. per ton. Except house coals, the heavy demand for fuel which set in last autumn continues. Orders from abroad are coming in at a record rate, and it is estimated that the exports of coal from the United Kingdom for the first six months of 1907 will show an increase of not far from three million tons as compared with those for the corresponding period of 1906.

Life Insurance without Examination. — Many persons willing and even anxious to insure their lives object to the medical examination, which until lately was indispensable, and remains with most offices a condition of insurance, but one well-known and enterprising life office has for some time past consented, upon conditions, to waive the medical examination. The result has been considerable additional business, and the managers of the institution are well satisfied with the experiment. The conditions under which insurance without examination are effected are as follows:—Insurance is not effected after the age is over 50, or for less than £100, but with these limitations the company will entertain proposals under whole life and endowment assurance tables at the ordinary rates of premium, subject to being satisfied from the statements made by the proposers that their lives are not ineligible on account of family or personal history. If the life assured die during the first year following the date of assurance, the amount payable will be one-third of the sum assured, if he die during the second year two-thirds of the sum assured, and

on a claim occurring at any time after two years from the date of assurance, the full sum assured will be payable. In the event of the life assured's death from accident at any time, the full sum assured will be payable. No assignment of a policy is allowed until the expiration of two years from the date of assurance.

Dairy Farming.—A writer in the *Times* combats the general opinion that British farmers have much to learn from Denmark, which is so frequently held up as an example to Great Britain, especially in connection with dairy farming. The writer in the *Times* submits figures to show that the British dairy farmer realises twice as much for his milk as does his Danish rival. The latter sells to to the factory at something less than 4d. per gallon, whereas in this country the price for new milk, delivered at the station, ranges from 6d. to 8d. But that only shows that the British farmer has a better market for his milk than the Danish, which is obviously the case, seeing that Great Britain is studded with highly prosperous, industrial towns, whereas in Denmark it is pretty well all country. Admittedly Denmark excels in co-operation, which has never taken much root among English farmers, but the cheaper production of Denmark is largely due to lower wages, and if a larger number of people are maintained on the land in Denmark than in Great Britain the explanation is to be found in the unwillingness of the Dane to emigrate, and the consequent necessity of finding a living upon the land since the opportunities of town life are not as a rule open to him. But whilst a good deal of exaggeration is frequently indulged in when comparison is made between British and Danish farming methods, it may be allowed that in some respects the Danes set an example that British farmers might follow with advantage. For instance, they pay much greater attention to cleanliness and to proper packing. Even now cows and pigs upon English farms are often kept in a filthy condition, methods of milking and the transport of milk leave much to be desired; and the benefits of co-operation, which are so marked in Denmark, are very imperfectly appreciated in Great Britain though, strangely enough, much greater progress in this direction has of late years been noticeable in Ireland.

The Hematite Iron Trade.—The hematite iron trade continues to be remarkably prosperous. The exports to America and the continent show large increases and there is a strong demand for early deliveries of the metal. During the first week of June 10,922 tons of iron, and 14,002 tons of steel were exported as compared with a total in the two classes last year of 8,732 tons, an increase of 16,192 tons. The total shipments this year are 409,833 tons as compared with 324,596 tons last year, an increase of 85,237 tons. Warrant stocks show renewed reduction, which must further strengthen the market. They stand at 30,793 tons, or less than a week's output of the furnaces of the district. Additional furnaces are to be put in blast to cope with the demand, for makers still hold large orders for delivery to the United States and the Continent, and local steel makers are also requiring larger deliveries. It looks as if the present year will be a record one in the north-west of England hematite iron trade.

Colonial Wool.—The figures of the wool exports from Australasia are remarkable. They cover the eleven months to the end of May, and show an increase of 230,000 bales as compared with the corresponding period of last year. The increase from Australia alone is 216,000 bales. When the drought ended in 1902 the exports had fallen below 1,000,000 bales. The previous highest record was not quite 1,600,000 bales. For the eleven months to May the exports were 1,629,000, so that with another month of the year to run they exceed those of any previous year by 30,000 bales, and are 640,000 bales more than they were in the years 1902-3. The increase for 1907 8 promises again to be very large. The arrivals of Colonial wool in this country up to last week since the closing of the list for the late auctions in London was 213,000 bales, of which 112,500 bales were forwarded direct to consumers here and on the Continent. The methods adopted by growers of Colonial wool for the realisation of their clips have been greatly changed in recent years. Formerly nearly everything was sent to London for sale, but now the clip, in large part, changes hands in Australian markets. How serious is the competition of Colonial with London brokers will be understood, says the *Manchester Guardian*, when it is remembered that during the present wool year, which will come to an end on the 30th inst., more than three-fourths, and probably not less than seven-eighths of the entire Australian clip, amounting to 1,700,000 bales, will have changed hands in Australia. The "epidemic," as London brokers and warehousemen call it, is extending every year, and it now looks as if the proportion of direct purchases in New Zealand, Tasmania, and South Africa will, in a few years, be quite as large as the Australian. Naturally, the London brokers are unwilling to lose their business without a struggle, and circulars are issued by some of them from time to time to prove that London is the best market in which growers can realise their wool. Australian newspapers, on the other hand, urge that no sensible pastoralist can be so blind to his own interests as to ship his wool to London instead of selling in the Colonial markets. All Australians are unanimous as to that, the divergence shows itself when the comparative merits of the various markets in the Commonwealth are considered. Melbourne, Sydney, Brisbane, Adelaide, are struggling for the business that not so long ago was transacted almost exclusively in London.

GENERAL NOTES.

THE SS. "ADRIATIC."—On May 8th there sailed from the Mersey a vessel larger than any that had hitherto crossed the Atlantic. The *Adriatic* cannot be described as the largest ship afloat, for the new Cunarders—the *Mauretania* and *Lusitania*—although they are not yet completed ready for service, considerably exceed even the *Adriatic* in dimensions and tonnage. The construction of the huge White Star liner has been somewhat thrown into the shade by the building of the two great ships of the rival company. Although not comparable with these latter in many respects, and, of course, intended for a different class of trade, the sailing of the *Adriatic* is a noteworthy event. Just thirty-five years ago the great Belfast shipyard of Harland and Wolff built another *Adriatic*—a ship famous in her day, and one of the finest vessels afloat at that time. She was 449 ft. 6 in. in length, 40 ft. 9 in. beam, and her gross tonnage was 3,887. The new *Adriatic* forms a striking contrast with her predecessor. Her length is 725 ft. 9 in.; breadth, 75 ft. 6 in.; depth, 50 tt.; and her gross tonnage, 25,900. The displacement is over 40,000 tons. She will carry 3,000 passengers in addition to the crew. The *Adriatic*, although making her maiden voyage from Liverpool, will henceforth use Southampton as headquarters, and arrived at that port on her return journey on May 30th, leaving again for New York on Wednesday last, thus commencing the regular weekly express service of the White Star Company between Southampton and New York. It is fourteen years since the American line adopted Southampton as its headquarters on this side of the Atlantic, since when the development of the port has been continuous and rapid, culminating this year in the transfer of the four White Star boats and the establishment of a branch yard at Southampton by Messrs. Harland and Wolff, work in connection with which is already in hand. It is stated that the Southampton Dock Board has decided to carry out the additional dredging rendered necessary for the accommodation of the new White Star vessels at its own cost, and not to depend on aid from the London and South-Western Railway Company to effect this, as was at first proposed, otherwise than by taking advantage of a loan from the company. The estimated cost is £50,000.—*The Engineer*.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 17...Geographical, University of London, Burlington-gardens, W., 8½ p.m. Major P. H. G. Powell-Cotton, "In the Equatorial Forests of Africa."

TUESDAY, JUNE 18...Asiatic, 22, Albemarle-street, W., 4 p.m. Mr. James Kennedy, "The Child Krishna, Christianity and the Gujars."

Statistical, 9, Adelphi-terrace, W.C. 4½ p.m. Annual General Meeting. 5 p.m. Mr. W. G. S. Adams, "Some Considerations relating to the Position of the Small Holding in the United Kingdom."

Zoological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, JUNE 19...Meteorological, 70, Victoria-street, S.W., 4½ p.m. 1. Mr. Francis Campbell Bayard, "Weather and Crops, 1891-1906." 2. Mr. Charles P. Hooker, "The Relation of the Rainfall to the Depth of Water in a Well at Cirencesier, 1903-1906."

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. E. M Nelson, "Eye-pieces for the Microscope." 2. Mr. F. Enock, "Life-history of the Tiger Beetle, *Cicindela campestris*."

British Archæological Association, 32, Sackville-street, W., 8 p.m.

THURSDAY, JUNE 20...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Dr. Maxwell T. Masters, "Distribution of Conifers of China." 2. Mr. Clement Reid and Mrs. Reid, "Pro-glacial Flora of Great Britain." 3. Dr. J. Stanley Gardiner, "Cruise of H.M.S. *Sealark*." Part II. 4. Mr. A. W. Waters, "*Tubucellaria*." 5. Dr. N. Wolfenden, "Cruise of the *Silver Belle*." 6. Mr. E. A. N. Arber, "Triassic species of *Zanisko* and *Plerophyllum*."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. A. T. Cameron and Sir W. Ramsay, "Some Properties of Radium Emanation." 2. Mr. V. H. Veley, "The Affinity Constants of Aminosulphonic Acids as determined by the aid of Methyl Orange." 3. Mr. M. A. Whiteley, "Azo-derivatives of 1 : 3-diphenylbarbituric Acid; Dynamic Isomerism amongt he coloured Hydrazones of 1 : 3-diphenylalloxan." 4. Messrs. G. T. Morgan and W. O. Wootton, "A series of coloured Diazo-salts derived from p-amino-aceto-α-naphthalide." 5. Messrs. J. T. Hewitt and H. V. Mitchell, "Colour and Constitution of Azo-compounds." Part I. and II. 6. Mr. F. D. Chattaway, "The Oxidation of Hydrazines by Free Oxygen." 7. Mr. F. L. Pyman, "Calmatambin: a new Glucoside." 8. Messrs. P. C. Ray and A. C. Ganguli, "The Decomposition of Hyponitrous Acid in presence of Mineral Acids." 9. Messrs. H. O. Jones and H. A. Wootton, "The Chemical Composition of Petroleum from Borneo." 10. Messrs. A. Senier and C. Austin, *a.* "The Synthesis of Phenonaphthacridines. Trimethylphenonaphthacridines." *b.* "The Condensation of Aldehydes with Mixtures of α-Napthol and α-Napthylamine: Synthesis of 7-Aryl $\begin{array}{c}\alpha\text{-N-}\alpha\\ /\\ \beta\text{-CH-}\beta\end{array}$ Dinaphthacridines. 11. Messrs. W. R. Lang and T. B. Allen, *a.* "An Improved form of Apparatus for the Rapid Estimation of Sulphates and Salts of Barium." *b.* "The Determination of Sugar by Fehling's Solution."

Optical, 20, Hanover-square, W., 8 p.m. Mr. W. A. Dixey, "A New Instrument to Measure the Fusion Power of the Eyes." 2. Discussion on "The Influence of Position of the Object on the Effective Value of High Power Sphero-cylindrical Lenses." Introduced by Mr. S. D. Chalmers.

Numismatic, 22, Albemarle-street, W., 6½ p.m. Annual meeting.

FRIDAY, JUNE 21...Art Workers' Guild, Clifford's-inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Methods of Painting."

Historical, Lecture-hall, Field-court, Gray's-inn, W.C., 5 p.m.

Quekett Microscopical Club, 20, Hanover-square, W., 8 p.m.

Journal of the Society of Arts.

No. 2,848. VOL. LV.

FRIDAY, JUNE 21, 1907.

FINANCIAL STATEMENT.

The following statement is published in this week's *Journal* in accordance with Sec. 40 of the Society's By-laws —

TREASURERS' STATEMENT OF RECEIPTS AND PAYMENTS FOR THE YEAR ENDING MAY 31ST, 1907

Dr

	£	s	d	£	s	d
To Cash in hands of Messrs Coutts and Co 31st May 1906				2,546	18	10
,, Subscriptions	5,760	6	0			
Life compositions	621	12	0			
				6,381	18	0
Dividends and Interest				652	12	5
Ground Rents				652	10	10
Examination Fees				3,332	5	10
Conversazione, 1906 (sale of tickets)				102	10	0
Advertisements				667	12	0
Sales &c —						
"Cantor" Lectures	39	18	9			
Examination Programmes	50	1	8			
Fees for use of meeting rooms	39	18	0			
Journal	116	11	10			
				246	10	3
,, Donations to Examination Prize Fund — Clothworkers Company				20	0	0
Committee on Leather for Bookbinding — Sale of Reports				72	17	0
Donations to Building Fund				20	10	0
				£14,696	5	8

Cr

	£	s	d	£	s	d
By House —						
Rent Rates and Taxes	85	1	4			
Insurance Gas Coal House expenses and charges incidental to meetings	352	5	7			
Repairs and Alterations	88	3	3			
				[illegible]	10	2
Office —						
Salaries and wages	2,327	10				
Stationery Office Printing and Lithography	485	7	3			
Advertising	[illegible]	11	[illegible]			
Postage Stamps Messengers Fares, and Parcels	380	17	2			
				3,[illegible]	[illegible]	[illegible]
,, Library Bookbinding &c				105	14	4
,, Conversazione (1906)				61	5	8
,, *Journal* including Printing and Publishing				2,515		1
,, Advertisements (Agents and Printing)				335	1	2
,, Examinations				3,472	10	
,, Medals —						
Albert	20	18	0			
Society's	27	10	0			
				48	8	0
,, "Owen Jones" Prizes				5	5	0
,, Drawing Society's Prizes				11	18	6
North London Exhibition Prizes				29	8	0
,, Juvenile Lectures				20	0	0
,, "Howard" Lectures				11	12	9
,, "Cantor" Lectures				171	2	6
,, Sections —						
Applied Art	60	0	0			
Colonial	45	15	0			
Indian	68	9	3			
				174	4	3
,, Committees (General Expenses)				18	3	4
,, Committee on Leather for Bookbinding				1	10	0
,, Investments — War Loan				20	10	0
				12,039	13	10
,, Cash in hand and at Messrs Coutts and Co, May 31st, 1907				2,656	11	10
				£14,696	5	8

Liabilities.

	£ s. d.	£ s. d.
To Sundry Creditors	668 14 1	
,, Examiners' Fees	1,075 10 0	
,, Examination Prizes and Medals	200 0 0	
,, Sections :—Applied Art, Colonial, and Indian	160 0 0	
,, Accumulations under Trusts	442 18 1	
		2,547 2 2
,, Excess of assets over liabilities		25,322 3 2
		£27,869 5 4

Assets.

	Amount of Stock, &c. £ s. d.	Worth on 31st May, 1907. £ s. d.	£ s. d.
By Society's Accumulated Funds invested as follows:			
Newcastle-on-Tyne 3½ per cent. stock	3,000 0 0	2,970 0 0	
Canada 4 per Cent. Stock	500 0 0	510 0 0	
South Australia 4 per Cent. Stock	500 0 0	505 0 0	
N.S. Wales 3½ per Cent. Stock	530 10 1	527 16 10	
N.S. Wales 4 per Cent. Stock	500 0 0	540 0 0	
G. Indian Pen. Ry. 4 per Cent. Debenture Stock	217 0 0	248 9 3	
Queensland 4 per Cent. Bonds	1,500 0 0	1,530 0 0	
Natal 4 per Cent. Stock	500 0 0	530 0 0	
Ground Rents (amount invested)	10,496 2 9	10,496 2 9	
Metropolitan Water Board B. Stock	321 15 9	281 10 8	
New River Co. shares	6 0 0	6 0 0	
National War Loan	3,134 8 3	3,071 14 3	
	21,205 16 10		21,216 13 9
,, Subscriptions of the year uncollected		814 16 0	
,, Arrears, estimated as recoverable		310 0 0	
			1,124 16 0
,, Property of the Society (Books, Pictures, &c.)			2,000 0 0
,, Advertisements due			471 3 9
,, Cash in hand and at Messrs. Coutts and Co., 31st May, 1907			2,656 11 10
,, Do. on Deposit (against interest on Trusts)			400 0 0
			£27,869 5 4

Funds held in Trust by the Society.

	£ s. d.	
Dr. Swiney's Bequest	£4,477 10 0	Ground-rents, chargeable with a sum of £200 once in five years.
"John Stock" Trust	100 0 0	Consols, chargeable with the Award of a Medal.
"Benjamin Shaw" Trust for Industrial Hygiene	133 6 8	,, ,, ,, of Interest as a Money Prize.
North London Exhibition Trust	192 2 1	,, ,, ,, ,,
"Fothergill" Trust	388 1 4	,, ,, ,, of a Medal.
J. Murray and others, in aid of a Building Fund	75 14 4	,, £54 18s. od. and National War Loan £20 16s. 4d.
Subscriptions to an Endowment Fund	562 2 2	,,
Dr. Aldred's Bequest	220 2 3	,, chargeable with the Award of a Prize.
Thomas Howard's Bequest	571 0 0	Metropolitan Railway 3½ per Cent. Preference Stock, chargeable with the Award of a Prize for an Essay.
Dr. Cantor's Bequest	648 19 7	Bombay and Baroda Railway Guaranteed 3 per cent. Stock } Interest applied to the Cantor Lectures.
	3,273 16 6	India 3 per cent. Stock } Interest applied to the Cantor Lectures.
	2,695 11 3	Ground-rents } Interest applied to the Cantor Lectures.
"Owen Jones" Memorial Trust	423 0 0	Canada 4 per Cent. Stock, chargeable with the Award of Prizes to Art Students.
"Mulready" Trust	105 16 0	South Australia 4 per Cent. Stock, the Interest to be applied to keeping Monument in repair and occasional Prizes to Art Students.
Alfred Davis's Bequest	1,953 0 0	Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock. Interest at the disposal of the Council for promoting the objects of the Society.
Amount to cover accumulated Interest on Trust Funds	400 0 0	On Deposit with Messrs. Coutts and Co.
	£16,220 2 2	

TOTAL OF INVESTMENTS, &c., STANDING IN THE NAME OF THE SOCIETY (INCLUDING SOCIETY'S ACCUMULATED FUNDS AND TRUSTS AS ABOVE).

	£	s.	d.
Ground Rents (amount of cash invested)	£17,669	4	0
Consols	1,650	12	6
Metropolitan Railway 3½ per Cent. Preference Stock	571	0	0
Bombay and Baroda Railway, Guaranteed 3 per cent. Stock	648	19	7
India 3 per cent. Stock	3,273	16	6
Canada 4 per Cent. Stock	923	0	0
South Australia 4 per Cent. Stock	605	16	0
New South Wales 3½ per Cent. Stock	530	10	1
New South Wales 4 per Cent. Stock	500	0	0
Great Indian Peninsula Railway 4 per Cent. Guaranteed Debenture Stock	2,170	0	0
Queensland 4 per Cent. Bonds	1,500	0	0
Natal, 4 per Cent. Stock	500	0	0
Newcastle-on-Tyne 3½ per cent. Stock	3,000	0	0
Metropolitan Water Board B. Stock	321	15	9
New River Company Shares	6	0	0
National War Loan	3,155	4	7
Cash on Deposit with Messrs. Coutts and Co.	400	0	0
Society's Accumulated Funds ... 21,205 16 10			
Trust Funds held by Society ... 16,220 2 2	£37,425	19	0

The Assets, represented by Stock at the Bank of England, and Securities, Cash on Deposit, and Cash balance in hands of Messrs. Coutts and Co., as above set forth, have been duly verified.

CARMICHAEL THOMAS, } *Treasurers.*
GEORGE BIRDWOOD, }

H. T. WOOD, *Secretary.* KNOX, CROPPER & CO., *Auditors.*

Society's House, Adelphi, 20th June, 1907.

NOTICES.

ANNUAL GENERAL MEETING.

The Council hereby give notice that the One Hundred and Fifty-third Annual General Meeting for the purpose of receiving the Council's Report and the Treasurers' Statement of receipts, payments, and expenditure during the past year, and also for the election of officers and new members, will be held in accordance with the By-laws on Wednesday, 26th June, at 4 p.m.

(By Order of the Council),
HENRY TRUEMAN WOOD,
Secretary.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

The Tropical-house, containing the Giant Water Lily (Victoria Regia), and other interesting tropical plants, will be open to visitors, and will be specially illuminated for the occasion.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A Selection of Music will be performed by the String Band of the Royal Marine Light Infantry (Portsmouth Division) in the Conservatory, and by the Band of H.M. Coldstream Guards in the Gardens, commencing at 9 o'clock.

A "Watteau" Pastoral Play in three acts, entitled "La Marquise," will be performed in the Gardens by Mr. Patrick Kirwan's Idyllic Players, commencing at 9.30 p.m.

A Concert and Entertainment, under the direction of Mr. Patrick Kirwan, will be given in the Club-house at 9.45 and 10.45 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a

card for a lady. These tickets will be issued next week. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

Further particulars as to the musical and other arrangements will be given in the Programmes, which will be distributed on the evening.

PRIZE FOR LIFE-SAVING APPARATUS FOR USE IN NOXIOUS ATMOSPHERES.

The Council of the Society of Arts are prepared to award, under the Fothergill Trust, a Gold Medal, or a prize of £20, for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious.

It is intended that the apparatus sent in shall be submitted to practical trials and tests.

In the award of the Medal regard will be had, firstly, to excellence of design and contrivance, and, secondly, to excellence of manufacture. Credit will be given to such parts of the apparatus as are the invention of the exhibitor; the object being to distinguish the apparatus which gives the best promise of being practically useful.

Inventors intending to compete should send in a notice of their intention, together with a full description of their inventions, not later than 31st March, 1908, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.; and in cases in which the apparatus has been put into actual use, the experience of such use should be given, and the special points of merit of the apparatus indicated.

Notice of the place to which the apparatus is to be sent will be subsequently given to those competitors whose apparatus the judges may desire to test, together with an indication of the tests, and of the manner in which they will be conducted.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

COMMITTEE ON THE DETERIORATION OF PAPER.

A meeting of the above committee was held on Wednesday, the 12th instant, at 4 p.m. Present:—Sir Steuart Colvin Bayley, K.C.S.I., C.I.E. (in the chair), Clayton Beadle, W. C. Knight Clowes, M.A., Charles G. Cresswell, C. F. Cross, F.C.S., Cyril Davenport, Hugo Müller, Ph.D., F.R.S., Sir Boverton Redwood, D.Sc., F.R.S.E., William J. Russell, Ph.D., F.R.S., Carmichael Thomas, Prof. J. Millar Thomson, F.R.S., Dr. Quirin Wirtz, M.A., F.I.C., and Sir Henry Trueman Wood (Secretary).

EXHIBITIONS IN GREAT BRITAIN AND IRELAND SINCE 1890.*

By the Secretary of the Society.

Since the publication in the Society's *Journal* of November 8th, 1889, of the Memorandum on Exhibitions held in Great Britain and Ireland, which was prepared at the request of the Secretary of State for Foreign Affairs for the use of the Committee then occupied in organising the exhibition at Chicago, there have not been many exhibitions held in this country of an important character, or properly entitled to the epithet International.

The largest and most successful was that held in Glasgow in 1901. This resulted in a surplus of over £30,000. One held in the following year at Wolverhampton was less successful, as it resulted in a deficit of about £34,000. This was on a smaller scale than Glasgow. A still smaller exhibition was held at Bradford in the year 1904, which left a

* Supplementary to a Memorandum on British Exhibitions issued in 1889. (*See* vol. 37, p. 900.) Prepared at the request of the Board of Trade for the information of the Japanese Government.

surplus of nearly £15,000. A successful exhibition was also held at Cork in 1902, but the surplus of over £6,000 was due to the liberality of the subscribers, without whose assistance the exhibition would not have paid its expenses. In 1896 one was held at Cardiff; it had a small balance on the wrong side. Many smaller exhibitions were held at some of the chief centres of industry, Manchester, Liverpool, Bristol, Birmingham, &c. Some of these were of the nature of private speculations, others were promoted by local committees. Most of them may be said to have been popular and successful. In many cases they were certainly profitable to their promoters and beneficial to the local industries.

In London no large exhibitions have been held, though there have been a great number of various characters, particulars of some of which are given a little later on. It is certainly the fact, as far as this country is concerned, that the tendency of late years has been towards exhibitions of a special character dealing with particular trades or industries. These are of necessity small as compared with the large International Exhibitions of the past; but they seem on the whole to be regarded as more useful for business purposes by manufacturers and traders than such large exhibitions. They do not necessarily appeal specially to the general public, but they offer useful opportunities for the transaction of business, and, judging from their success, such opportunities are much appreciated and generally utilised.

It must not be forgotten that exhibitions on the scale of Paris, Chicago, or St. Louis, can only be carried on at a very heavy loss, which loss has to be made good by subscriptions or grants from one source or another. The receipts from the admission of visitors, and from the various payments made by those visitors, a large proportion of which of necessity reaches the exhibition coffers, can never be sufficient during the season for which an exhibition is open to meet the very heavy charges for buildings, installation, &c., when these are on the large scale and of the elaborate character induced by international rivalry. It may be worth while for a country or a city to incur this loss in view of the indirect benefits gained, but it must be regarded as most probable that in the future the occasions on which such indirect benefits will counterbalance the certain loss will be few and far between, though they are quite likely at intervals to recur. It is probable that in the case of Paris the indirect profits to that great city are sufficient to induce the Government to keep up the series of Paris Exhibitions, and it would be a matter for regret if the series were not continued, but it is difficult to name any other city which would gain in the same way. A new and rising country, anxious to develop its industries, might be inclined to face the cost of advertising them by an exhibition on the international scale, but so far as careful consideration of the conditions may justify prophecy, it seems unlikely that in the immediate future any of the older countries will be willing to meet the necessary expenditure. It, therefore, seems reasonable to expect that in the future we shall have a number of smaller exhibitions, of which a considerable proportion will be confined to some special subject or group of subjects, rather than any of the great International Exhibitions of the past.

I.—London Exhibitions.

During the period under consideration there have been in London no important exhibitions of an international character, but it may be useful to put on record some account of the exhibitions which have been held. The two most important exhibitions held in London during the period 1890-1906 were certainly the Royal Military Exhibition at Chelsea in 1890, and the Royal Naval Exhibition at the same place in 1891. Both of these were extremely successful. They were held on ground belonging to the Chelsea Hospital, an area of about 7½ acres. The exhibits were mainly loans, but trade exhibitors were charged 5s. per square foot.

The number of visitors to the Royal Military Exhibition, 1890, was 923,761. The total receipts of this exhibition were a little over £55,000, of which £36,750 came from admissions, and about £9,000 from concessions, sale of space, &c. A little over £6,000 was received from donations. The expenses amounted to over £45,000, of which £18,500 was for buildings, installation, &c. The surplus was nearly £10,000.

The attendances at the Royal Naval Exhibition 1891, were much larger—2,351,683. The total receipts were nearly £155,500, of this admissions accounted for £109,000, and concessions, space, sale of catalogues, &c., for about £46,500. The expenditure amounted to about £108,500; of this £36,000 was for buildings, installation, restoration of grounds, &c., £10,700 for entertainments, £6,500 for

illuminations. There was a balance of £47,000. The profits from these two exhibitions were devoted to certain military and naval benevolent institutions.

As mentioned in the previous memorandum, a series of exhibitions was started at Earl's Court after the last of the South Kensington exhibitions—the Colonial and Indian Exhibition held in 1886. These have been continued since, and have proved very popular, and well attended. They are in the hands of a private company, and are believed to have been profitable, the grounds being a very popular place of resort during the summer,* and providing what is much appreciated in London, a place of out-door recreation under good and careful management. During the same period a number of exhibitions of different characters have been held at the Crystal Palace, Sydenham. These have most of them been of a special character, and though some of them have been termed International, they were none of them genuine International Exhibitions.†

At the Imperial Institute several exhibitions have been held, all of them devoted to some special subject. The first of these was in 1894, and dealt with Pottery; in the next year (1895) the subject was Photography, in 1897 there was a Yachting and Fisheries Exhibition, in 1898 an exhibition of Acetylene Generators, in 1899 an exhibition of Ecclesiastical Art, and in 1900 one of English Education.

In 1899, at the suggestion of the Society of Arts, the Science and Art Department held an exhibition of Lithography to commemorate the invention of lithography by Senefelder in 1798. This was followed by a series of exhibitions of Methods of Illustration: 1901, Illustration by Typographical Methods; 1903, Engraving and Etching; 1905, Photogravure and other Photographic Methods. These were international, and included large and representative collections of foreign work.

A small general Industrial Exhibition was held in the People's Palace, East London, in 1896.

In addition to these were many other smaller exhibitions, and also a number of exhibitions dealing with special subjects, most of which were at the Agricultural Hall, or at Olympia. The more important of these dealt with such subjects as Tramways and Light Railways, Bicycles, Electrical Appliances, Engineering, Motors, Building Materials, Colliery and Mining Plant, Gas, Confectionery, Furniture, Brewers' Products, Groceries and Provisions, Tobacco, Boots and Shoes, &c.

The occasional exhibitions of Arts and Crafts promoted by a committee formed for the purpose should be mentioned, as affording interesting evidence of the character of, and the changes of method in, the artistic industries of the country.

II.—Provincial Exhibitions.

Glasgow.—A second exhibition was held at Glasgow in 1901. This, like the previous exhibition of 1888, attracted a very large number of visitors and was a considerable financial success. The total receipts amounted to £404,105, of which £283,024 was from admissions, £84,122 from refreshment and other concessions, and £34,923 payments for space. The surplus, as estimated in the published balance-sheet, was £30,571. It was expected this would be somewhat increased by the sale of the buildings. The cost of the buildings and grounds was £222,886, £37,936 was paid for music and entertainments, and there was a Women's Section costing £1,314. The general administration expenses were given as £51,574, and the engineer's department £36,890. The total number of admissions was 11,559,649. The admission was one shilling, children half-price, and during a certain portion of the exhibition the entrance after five p.m. was reduced to sixpence.

Bradford.—In the year 1904 an exhibition was held in Bradford to inaugurate the opening of the Cartwright Memorial-hall, which was presented to the city by Lord Lister. This was not entitled an International Exhibition, but there were a few foreign exhibitors. The exhibition was not on a large scale, but it was a distinct financial success. There were in all nearly two million and a-half visitors, but this number appears to have

* The present series commenced in 1895, and include the following:—Empire of India Exhibition, 1895; Empire of India and Ceylon Exhibition, 1896; Victorian Era Exhibition, 1897; International Universal Exhibition, 1898; Greater Britain Exhibition, 1899; Woman's Exhibition, 1900; Military Exhibition, 1901; Paris in London Exhibition, 1902; International Fire Exhibition, 1903; Italian Exhibition, 1904; Naval, Shipping and Fisheries Exhibition, 1905; Imperial Royal Austrian Exhibition, 1906.

† The Secretary of the Crystal Palace has kindly furnished the following list of exhibitions held there since 1890:—Photographic (1890), Mining (1890), Horticultural (1891), Photographic (1891), Electrical (1892), Photographic (1893), Sports and Pastimes (1893), South African (1895), Horse-drawn and Horseless Carriages (1896), "Imperial Victoria Exhibition" (1897), Photographic (1898), "Article Club" (1899), Music (1900), Naval and Military (1901), American (1902), Engineering and Hardware (1903), Music (1903), Food and Grocery (1903), Indian and Colonial (1905), Food, Health and Hygiene (1906), Pianoforte and Music Trades (1906).

included rather more than 40,000 free admissions. The total receipts amounted to £66,114. The expenditure was £51,148, leaving a surplus of £14,966. This surplus was devoted to the expenses of the Cartwright Memorial-hall—£5,000 towards the cost of erection, and £10,000 to the purchase of works of art, and furnishings for the hall. The receipts from admissions were £41,828. The amount received in payments for space was £4,551, the charge to exhibitors being 3s. per square foot. £11,688 was received from the various concessions and entertainments.

Wolverhampton.—In 1902 an International Exhibition was held at Wolverhampton. Financially this was unfortunately very far from successful, as it resulted in a deficit of about £34,000, which had to be met by the guarantors. The total expenditure was about £93,000—buildings £35,174, power and light £9,088, entertainments £13,986, fine arts £2,000, advertisements £5,514. The total receipts were about £59,000—season tickets £9,117, admissions £27,000, sale of space £6,033, concessions £12,056.

Cork.—An International Exhibition was held at Cork in 1902. This resulted in a surplus of £6,179, but it can hardly be said that this was earned by the exhibition inasmuch as donations were received amounting to nearly £16,000. The total receipts were £61,519; the expenditure was £55,340. Besides the amount of donations above mentioned the principal items of receipts included £26,000 admissions, £8,500 sale of space, and various concessions and other receipts £9,500.

The exhibition was re-opened in 1903, and a portion of the surplus was carried forward towards the expenses of the second year. The remainder was applied to the purchase of ground for a park.

Cardiff.—A Fine Art, Industrial, and Maritime Exhibition was held in this City in 1896. The exhibition was held in Cathays-park, the use of which was granted by the late Lord Bute for the purpose. The number of admissions amounted to about a million. The expenditure amounted to £31,000, of which buildings and machinery came to about £15,000, and electric light £3,000. The receipts amounted to rather less than £30,000, the balance of £1,700 being made up by the guarantors. Of the receipts £22,500 was from admissions, and £5,700 from rent of space, concessions, &c.

Dublin.—An International Exhibition is now being organised in Dublin. The arrangements are now (January, 1907) far advanced towards completion, and hold out every promise of success.*

AFRICAN TREE RUBBER.

The *Kew Bulletin* (No. 5, 1907), quotes a letter addressed to the editor of the *Agricultural News*, Barbados (vol. vi., No. 127, p. 77), Mr. H. Hesketh Bell, C.M.G., which supplies an interesting account of the system of tapping indigenous *Funtumia elastica* trees in Uganda, and of the subsequent treatment of the latex and preparation of the product for the market: —

Government House, Entebbe, Uganda,
January 3, 1907.

"I have just been reading in the Bulletin of the Imperial Department of Agriculture a very interesting account by Mr. Joseph Jones of the experimental tapping of various kinds of rubber trees in the Dominica Botanic Station, and I note that he is rather troubled by the dark colour of the produce, more especially that yielded by the Funtumia trees. In view of the great interest that is now being taken in the cultivation of rubber in the West Indies, it may be useful to some of your readers to know how the latex of rubber is treated in Uganda.

"In some of the great forests of this territory, considerable numbers of the *Funtumia elastica*, or 'Lagos Silk Rubber,' are found, and concessions for the sole right of tapping these trees are held by various companies. While visiting the Budonga Forest lately, I had an opportunity of observing the manner in which the crude latex is treated. The milk is obtained by making small 'herring-bone' incisions in one side of the trunks of the trees. These incisions are made with a V-shaped tapping tool, and reach from the base of the tree up to a height of 40 or 50 feet. *Funtumia* growing in a forest in its natural condition, has a slender, straight stem of great height, and branches only at the top. The trees are tapped every three months, so that, in each year, every side of the trunk has been made to yield its milk. The average yield of latex, at each tapping, is about one quart from each tree, and each stem may be expected to give about one pound of pure rubber per annum.

"The milk is brought at once to the factory, and is allowed to stand for a couple of days in large earthenware pots. It is then strained through pieces of red cotton, known as 'Turkey red,' for the removal of impurities. An equal quantity of water is added to the latex, and about a pint of the mixture is placed at a time in a small earthenware vessel. This small pot is then placed in a larger vessel containing water maintained at a temperature just below boiling point, after the fashion of a 'bain-marie.' Carbonate of potash is added in the proportion of 1 per cent. to the latex and water, and the mixture is stirred

* Since the date when this memorandum was prepared, the Exhibition has been opened, and is now believed to be pursuing a successful career.

with a wooden spoon until it coagulates. This usually occurs after three or four minutes. In the factory which I inspected there was a rough and ready 'range' of six small fires, so that half a dozen lots of latex could be dealt with simultaneously. Each pot, however, required the attention of one man. The carbonate of potash appears to prevent the rubber from turning to a dark colour. As soon as the latex has coagulated, the 'dollop' of rubber is taken out of the pot and placed under a press, so that all the moisture may be extracted from it. The press is very much like the sort used for taking copies of letters in offices, and being supplied with four or five boards can deal with several cakes of rubber at a time. The one I saw was worked by two men, and the pressure exerted was so great that each clot of rubber was quickly transformed into a very thin 'pancake' of creamy-white colour, each bearing the initials or brand of the company. This process very effectually extracts not only all the water, but also nearly all the resin in the rubber. The pancakes, after passing through the press, are thoroughly washed in water and placed to dry in the shade, on shelves made of reeds. The rubber gradually assumes a dark amber colour, but it is almost perfectly clean and transparent. In a few days it is fit for transport. I have much pleasure in sending you a sample of the rubber thus prepared, and would ask you, after inspection, to send it to the Curator of the Botanic Station at Dominica.

"A considerable quantity of *Funtumia* has been planted in the West Indies during the last two or three years and these notes may be of interest to the planters there. I may add that the produce of the *Funtumia*, obtained by the process above described, is now selling in London at 5s. 6d. per lb., a price almost equalling that obtained for the best Para. It has heretofore been thought that *Funtumia* rubber could not compare in value with the product of Para or of Castilloa."

OPENINGS FOR THE MOTOR TRADE IN SOUTH AFRICA.

South Africa, and especially Johannesburg and the Witwatersrand, present a most attractive field for the sale of automobiles, and one which has engaged the close attentions of motor-car manufacturers generally, with the result that large numbers of cars of all descriptions have been sold. There still, however, appear to be good openings for an increased importation. Some manufacturers seem to be quite content with an intermittent and spasmodic forwarding to South Africa of beautifully prepared catalogues. This method, while probably calling for no great outlay on the part of any one concern, is nevertheless an absolute waste of printed matter, postage and time. According to a recent report from Cape Town of the special agent of the American Department of Commerce, it cannot be said to involve a waste of time on the part of present or prospective automobile users in South Africa, for from all indications and comments it is perfectly safe to say that no one pays any attention to them. Automobiles in South Africa are not an article of luxury indulged in solely by those desiring a car for pleasure and recreation. They are necessary to the success of every man in South Africa who has relations with the mining industry, and this is proved from a slight view of the area over which the mining industry is spread. The Witwatersrand Reef extends in more or less unbroken line for upwards of seventy miles east and west, with Johannesburg approximating its centre. Many important mines are situated over fifty miles from that city. It is a daily occurrence for a mining engineer, or some officer of any of the large importing houses, to be obliged to visit a mine 40 or 50 miles or even further, and involving a run of 100 or 150 miles, which can only be accomplished by means of a motor-car. Railway and electric-car facilities, while sufficient to satisfy the demands of ordinary inter-urban travel around Johannesburg, are inelastic and incapable of affording means of transportation to the many places which daily demand the presence of those engaged in the management of the important affairs of the mines. By means of the automobile only can these points be reached. Carriages or other horse-power vehicles are unable to give the satisfaction, either in point of time or endurance obtained by the use of the automobile. In fact, so great a factor is time in supplying machinery "parts" and "spares," that in cases of emergency automobiles are often called into use in their delivery. The kind of automobile in use varies considerably according to the individual fancy, which is the result, in great measure, of the automobile experience of friends of the prospective purchaser, and also to the ability of the salesman to present the merits of his particular make. There are, however, certain basic principles or features dictated by the nature of the work which the car is called upon to perform—the physical condition of the roads over which it may have to travel, and certain climatic conditions. The average car in use along the "Reef" is selected for its ability to withstand the hard usage of the roughest roads, to climb steep gradients, and to cover a maximum mileage per gallon of petrol or gasoline. Gradients of 1 in 30 are to be met frequently in railway travel, while 1 in 14 is not uncommon for the ordinary country road. It is evident, therefore, that motors with a high hill-climbing efficiency are demanded. From fifteen miles upward per gallon of petrol are now required of new cars, although from twelve to fifteen miles is said to be the maximum of some now in use. Tho horse-power of motors ranges from 6 up to 26-30 horse-power, according to the idea of the individual, but great speed is not a deciding factor, and, in fact, high-speed cars, excepting on exceedingly rare occasions, are obliged to run on one-fourth or one-half their capacity by reason of the roughness of the roads. Steam-cars are not to be found on the Rand to any

extent. Both chain-drive and direct shaft-drive cars are popular. In chain-drive, the centre-drive chain is impossible on account of the great quantity of obstructions found, only side-drive chains being suitable. With many, however, the direct shaft-drive is preferred on account of the great amount of sand to be found in all parts of South Africa, which cuts chains so rapidly as to reduce greatly their life, and is accountable for a large number of breakages. A high clearance is absolutely imperative in all cars. A clearance of at least eleven or twelve inches is demanded, and anything greater without inducing top heaviness is a desirable feature. Four forward speed gears and one reverse gear are regarded as the essential of the best motor car along the Reef. As the climate of South Africa is exceedingly dry, with the exception of the narrow coast belt, and the rays of the sub-tropical sun are quite direct, the effect upon all wooden constructions is at once evident in motors after a few months' service. All veneering, box-work, and fittings of wooden construction are dried up, warped, and twisted out of shape. To meet this action of the climate all cars now sold have these parts finished in aluminium. Because of the heat of this latitude the air-cooled engines are valueless. According to past experience only water cooling has proved satisfactory. With regard to tyres the heaviest and best qualities only are satisfactory. The roads immediately surrounding Johannesburg, Kimberley, or any of the centres in the mining area, and in fact throughout South Africa, are only fairly well maintained at best, while within a very short distance they become mere tracks worn in the velt and in other places completely disappear. They consist of two ruts of varying depths and roughness flanking two paths worn by the hoofs of oxen or horses, while the centre is plainly marked by a ridge of from four to eight inches of rough earth and boulders, at times surmounted by a growth of rank vegetation. In many instances the trackless waste presents a far more attractive alternative than the roadway, in spite of the irregularly recurrent ant heaps, boulders and gullies. The country is essentially mountainous, or at best one of steep hills and heavy gradients, the roads not yet boasting of bridges. The register of automobiles in Johannesburg recently showed a total of 768 cars for the present year, and five years ago an automobile was a rarity. Upwards of 200 are reported by dealers to be in use in Cape Town. The prices of automobiles range from £350 upward, averaging about £400. At a moderate estimate by those qualified to judge, there is about £200,000 worth of automobiles in constant daily use in Johannesburg alone, while in the entire length of the reef at least twice the amount will be found. From information obtained from various users, the life of an automobile in South Africa is from two and a half to five years. New recruits are daily entering the ranks of motor-car owners, and a continued sale may be predicted both in supplying the places of worn-out cars and in meeting the requirements of new purchasers. It is urged that manufacturers should avail themselves of this field for the sale of motor cars by sending out salesmen directly to represent their machines, and who are competent to set forth the merits and features of their makes. They must be prepared to meet active competitors already in the field from every auto-producing country whose cars have a reputation for meeting the difficulties of South Africa motoring. There is a good sale for motor cycles, and most of those now seen are of British and German makes, the latter predominating. They range in prices from £40 to £50. While the Witwatersrand is the most profitable field in South Africa for these motor vehicles, still, throughout the different colonies, in the chief cities, there is a great interest taken in them, and sales are constantly being made. In Durban and Cape Town automobile and motor cycle clubs have regular runs, and motor enthusiasts are to be found everywhere. The value of motor vehicles imported into British South Africa, in the year ended June 30th, 1906, amounted to £172,569.

MADEIRA WICKER FURNITURE.

A considerable quantity of wicker furniture is now being made in Madeira, the osier or willow used in this industry being indigenous to the island, and scientifically known as the *Salix viminalis*. It is easy to propagate, grows freely, and has great resisting power, preferring a moist soil, though not exacting it. It is propagated by cuttings, a crop maturing in nine months. After being gathered, the ends are soaked in water until the tops begin to sprout, when it is easily peeled and ready to be worked up. The amount produced in the island is about 400 tons annually, the raw product being worth from £12 to £14 per ton. The willow when peeled is particularly white, with a silky and glossy appearance, for which it is greatly admired, although this freshness of surface does not long resist the bleaching effects of the sun. The American Consul at Funchal says it is noticeable that the finished article displays little, if any, artistic development from year to year. It is really surprising, to those familiar with the limitations of the artisans, that they have been able to show so much aptitude and delicacy of design, being altogether without examples to imitate, with little notion of design, and no educational advantages. Though they can be relied upon faithfully to execute, they can never furnish more than the mechanical skill to obey the creative instinct of others. The more common articles of furniture manufactured are chairs, retailed in Madeira from 6s. 6d. to 8s. 6d. each; sofas, from 12s. 6d. to 30s. each; tea tables, 6s. to 25s.; hampers, and a great variety of baskets, of all sizes, shapes, and colours. The exports are said to amount to at least £25,000 in value annually. The number of men employed in the industry is about 500, their pay being at the rate of 2s. a day.

HOME INDUSTRIES.

The Cotton Outlook.—In view of the sensational reports respecting the position of the cotton crop in the United States, some calculations made by Messrs. Neill Bros. are noteworthy. During the past four weeks 320,000 bales have come into sight, against an average of 315,000 for the corresponding weeks of the last four seasons. Add the average deliveries after this date of the last five seasons, namely 637,000, and the total of this season's commercial crop would be 13,697,000 bales, the largest on record. Messrs. Neill's estimate was 13,500,000, and that may be taken as roughly correct. The visible and invisible supply is expected to be sufficient for the consumption of American cotton in Europe and America up to the middle of November, against a four weeks shorter supply last year, so that if the new crop should be a month later the position of consumers would be still about the same as it was in 1906. With regard to the acreage for the new American crop, Messrs. Neill Bros. adhere to their forecast of 33,000,000 acres, which, on the basis of the minimum and maximum yields per acre during the last ten years, would indicate for 1907-8 a crop range of from 11½ to 15½ million bales, or, with an average production per annum, about 13½ million bales. But the crop has been very materially delayed by adverse weather, and a long maturing and picking season will be necesssary to ensure a good result. Invitations have been received from the National Association of Cotton Manufacturers, Boston, by various cotton employers associations in Lancashire to attend the International Conference of cotton growers, spinners, and manufacturers which is to be held at Atlanta, Georgia, United States of America, on October 7th, 8th, and 9th inst. A circular conveying this invitation states that "the purpose of this Conference is similar to that of the one held at Washington, May 1st and 2nd, 1906, in which it proposes to deal with the numerous questions as to the relationship between growers, dealers, and manufacturers of cotton." Arrangements are being made for a special train traversing the cotton-growing districts of the country, visiting some cotton mills, and also the principal American cities. The delegates will probably find ample confirmation of the opinion that the conditions under which the American cotton is picked, baled, marketed, and transported leave much to be desired. We are accustomed to associate the latest inventions and most up-to-date methods with American industrial enterprise, but the cotton business would seem to be exceptional. Old-fashioned gins and cumbersome compresses are still common. At the International Cotton Congress the American delegates were told that many of their large compresses are only fit for the scrap heap, and were advised to purchase compresses of the kind used in India and Egypt. The American bale is loosely packed, and has little more than half the density of the Egyptian bale. Its bulkiness increases the cost of carriage, it is more liable to become damp, and it is more subject to fire. The American delegates to the Congress admitted the justice of much of this criticism, but pleaded that they were doing their best to introduce a better state of things, and asked for the co-operation of European spinners. One of the objects of the autumn visit mentioned above is to devise means of making more direct the communications between the growers and the firms who spin cotton.

Fire Insurance.—It may be said roundly that the Insurance fire funds lost in 1906, owing to the San Francisco disasters, the increases of the previous three years. The total fire funds, exclusive of capital, decreased by £6,360,742 to £27,753,488, or rather less than three years profits. In 1903, after providing for dividends, the funds of the companies were increased by £2,989,000, in 1904 by £797,000, and in 1905 by £3,282,000, in all £7,068,000; while the decrease in funds during 1906 was £6,360,000. The heaviest decrease of the year in fire funds was that of the London, £690,846, followed closely by the London and Lancashire £643,667, next by the Royal Exchange £569,580, the Royal £532,585, the Phœnix £476,089, the Caledonian £444,337, and the North British £403,422. If the losses of the companies whose figures have not yet been issued are added to the known losses, and also those of the New Zealand, British American, and Western (of Toronto) Companies are added, the total net payments of British and Colonial fire insurance companies in San Francisco reach nearly eleven millions. But it is noteworthy that in proportion the smaller companies suffered most. For example, the deficit of the Alliance, after providing for claims and expenses, was only £232,865, the Caledonian £426,881; the one being 18·12 per cent. of premiums, the other 97·04. The only company transacting foreign and colonial business that made a profit in 1906 was the Guardian which withdrew from the United States some twelve years ago. If the essential principle of insurance finance is that dividends should be primarily based on interest earnings—and it is the principle upon which the best British insurance companies rest—it would seem that dividends will have to be reduced. The interest receipts, less tax and fixed charges, taking twenty-four chief companies for 1906, amounted to £1,368,614, an increase of £47,523 upon the previous year, whereas the dividends to be paid on account of 1906 amount to £2,030,724, an increase of £11,917,99 as against 1905. It may seem strange that in a year which saw the fire funds of these companies reduced by more than six millions there should be an increase in the interest on investments of £47,523, but the explanation is that although the San Francisco losses were incurred in April, 1906, they were not settled and paid until much later in the year, and the interest accruing in the interval appears in the accounts.

Insurance against Strikes.—The practice of insuring against financial loss due to strikes or lock-outs is being tried both in Germany and Austria. An

association of employers has just been formed in Bavaria for this purpose. It is open to all employers in the country, and the premiums paid are reckoned according to the total wages bill of the year, at the rate of three marks per thousand. In case of a strike the employer addresses a demand for compensation to the society, which is assisted by a committee. If the demand is valid the employer receives a grant of 25 per cent. of the average wages of each striker for each day the dispute lasts. Since in the case of an extensive strike the company might soon come to the end of its means, the claims are not settled until the end of the business year, and the rules provide that not more than a certain maximum shall be paid. Further provision against such a contingency is to be made by the accumulation of a large reserve fund. It will be interesting to follow the working of these associations. The difficulties in their way would appear to be considerable.

The Scottish Shalefield and Oil Industries.—A correspondent of *The Times* gives some notable figures relating to this industry. An estimate of the quantity of crude oil distilled in Scotland during 1905 is 57,350,000 gallons, and of the sulphate of ammonia manufactured at the works 47,000 tons. The approximate value of the various products obtained from the shale is at present only about one-third what it was in 1873, notwithstanding the improvements made in distilling and refining the oil, and in the recovery of the ammonia. The value of the shale at the mine mouth has decreased very much. In 1873 it was 10s. per ton, in 1905 it had fallen to 4s. 9d. per ton. The output over the whole of Great Britain has increased from 524,095 tons in 1873 to 2,496,785 tons in 1905; but whilst the 1873 output was valued at £262,047, that of 1905, which was nearly five times as great, was of very little more value, £593,334. Of the total output 2,493,051 tons came from Scotland in 1905; but Scotland produces only about one-fifth of the quantity of petroleum imported, which occurrs as a natural oil in America, Russia, and elsewhere. In 1905 the total import was 300,110,335 gallons, of which 68,493,036 gallons came from Russia, and 206,718,108 gallons from America. The fall in price, and the keen foreign competition, has been disastrous to the companies engaged in this industry. In 1873 there were fifty-one companies, now there are only seven. Within the past eighteen years over one and a half million pounds have been lost to shareholders. The capital at present engaged in the oil industry is slightly over £1,600,000, four-fifths of which is represented by three companies. These companies have had to reckon not only with falling prices and foreign competition, but with the gradual exhaustion of higher-grade shales; and if their position to-day is comparatively satisfactory, it is due to most careful management, and the skill and enterprise of their chemists and engineers.

Railway Fares.—It was recently intimated in these Notes as likely that a working arrangement would be arrived at between the companies engaged in the passenger traffic of the metropolis which would result in a revision of fares, having for its object some increase in the longer distance fares. An agreement has now been arrived at between the District Railway, the Metropolitan Railway, the Central London, and tube companies, which will affect fares between Hammersmith, the West-end, and the City. The Central London fares will be increased to threepence for the longer distances, and those of the Metropolitan and District will also be revised. The omnibus companies, both horse and motor, are at present outside the agreement, and it remains to be seen whether they can be persuaded to consent to a working arrangement. Although the question of fares presents difficulties in many parts of the country, the situation is most acute in London, where competition is keen and capital charges higher than elsewhere. In the country practically there are only two competitors, the railway and the tramway; in London there is a third, the motor omnibus. Many of the present fares in London are at the rate of less than a halfpenny per mile. In some provincial towns this scale leaves a profit upon working, but there working expenses are much lower. In London most of the tube lines are capitalised at from £600,000 to £800,000 per mile, and to get any dividend it is necessary that they should be earning revenue for sixteen or eighteen hours a day to the extent that is physically possible. With them working expenses are low; on the other hand, the motor 'buses which compete with them have a low capitalisation and high working expenses. They have nothing to construct but a car shed and a repair shop, but their working expenses are enormous—how high has, perhaps, still to be realised. As to the electric tramways, they also have low working expenses, but they suffer from high capitalisation owing to the use of the conduit system of construction. The tracks in the county of London alone cost about £35,000 per mile, and equipment, rolling stock, power-stations, sub-stations, &c., about as much more. It is only the horse omnibuses of London that enjoy both low capitalisation and low working expenses, and they will soon be things of the past. The only remedy, if the shareholders in the passenger-carrying companies are to get dividends, is to raise fares to a slight extent. Taking the five leading companies, the Metropolitan, District, Central London, City and South London, and North London, an average increase of a farthing a passenger would produce almost enough to raise ordinary dividends by 2 per cent., the outcome of the farthing on the basis of the passengers carried in 1906 being £278,530, and the amount required to pay the 2 per cent. £309,500. In the case of the District, which on the basis named would be benefited by the additional farthing to the extent of £65,500, the increase would be hardly sufficient to dispose of the present deficit in the fixed charges, but with the other companies named it would restore ordinary dividends to something like a reasonable level.

CORRESPONDENCE.

LUSTRE POTTERY.

SIR,—In the course of Mr. Burton's most valuable and interesting paper upon the above subject he remarks: "The beautiful ruby-red stain [of the Gubbio Potteries], which is given by the penetration of the copper vapours into the glaze, is much more pronounced. It has been suggested by many writers that the ruby-red was a secret of the potters of Gubbio, and that all the pieces of it which occur have been lustred in that town. We had no means of knowing whether such a belief is well founded or not, but it is certain that the Gubbio potters made great use of the ruby stain, and that in fact they used it as much for its beauty of colour as for its lustre quality."

In this connection it may perhaps not be without interest to note that the late Dr. J. Forbes Watson once handed to me a few small fragments of Gubbio "ruby" lustre ware, with the request that I would endeavour to ascertain to what metal or compound the fine red colour was due. My examination proved that in this instance the red stain was unquestionably due to the presence of gold, although an extremely minute trace of copper was also detected—probably only occurring as an impurity or alloy in the former. This, of course, partly answers Mr. W. C. Hancock' query as to analyses of lustre pottery.

To my thinking there is no evidence that any of the old Italian lustre "stains" were imparted by gold (or, for that matter, copper, or any other metal) present in the ware *as* such, *i e.*, in the metallic state. In fact, not only chemical tests, but microscopical, and, especially, spectroscopical ones also, quite negative such an assumption. Hence it seems probable that a silicate, or oxy-silicate, may the determining factor, or (considering that I have never yet come across a bit of the ware in question quite free from boron), more likely still, a boro-silicate of the metal.

W. LASCELLES-SCOTT.

Chemical and Physical Laboratories,
Little Ilford, Essex.
June 8th, 1907.

GENERAL NOTES.

NEW ZEALAND FLAX AT THE AZORES.—Last year *phormium tenax*, or New Zealand flax, was exported from the Azores to London to the amount of 88 bales. Mr. Consul Read, in his report on the trade and commerce of the Azores in 1906, says that a great development is in store for the industry, as the cultivation of this useful plant is one which demands little labour, a very important consideration labour in the islands being scarce and consequently expensive. An American engineer is sending from the United States four machines for extracting the fibre, for which a Hamburg firm have offered £30 per ton.

HAWAII.—British trade with Hawaii has been seriously affected by the American annexation. When the Organic Act for the government of the islands came into force in June, 1906, the import trade from the United Kingdom that had, under the Hawaiian tariff, amounted to £257,545 in 1895, and, in anticipation of the imposition of the United States tariff, had risen in 1899 to £354,931, dropped to £64,317 for the fiscal year ended June 30th, 1901. The average of the three years up to June, 1905, was £98,157 only; 1904 having given the highest record. For the year ended June, 1906, the value of imports from the United Kingdom fell to £87,399. Mr. Consul Layard, from whose report (Cd. 3283) these figures are taken, says that manufacturers in the United Kingdom still persist in making up their goods for the Hawaiian market in paper, and stamping with sizes that are not in use in the United States. American trade demands absolutely that hosiery and ready-made goods be boxed in the manner, and numbered as to the sizes, called for by the United States.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, JUNE 24...British Architects, 9, Conduit-street, W., 8 p.m.

TUESDAY, JUNE 25...Hellenic Studies, in the Rooms of the Society of Antiquaries, Burlington-house, W. 5 p.m. Annual Meeting.

Faraday Society, in the Library of the Institution of Electrical Engineers, 92, Victoria-street, S.W., 1. Messrs. W. R. Bousfield and T. Martin Lowry, "The Thermo-Chemistry of Electrolysis in Relation to the Hydrate Theory of Ionisation." 2. Dr. James C. Philip, "The Influence of Non-Electrolytes and Electrolytes in the Solubility of Gases in Water. The Question of Hydrates in Solution." 3. Dr. A. Findley, "The Dissociation of Hydrates as Indicated by their Equilibrium Curves." 4. Dr. George Senter, "Hydrates in Solution: Discussion of Methods Proposed for Determining Degree of Hydration." 5. Discussion on "Hydrates in Solution."

Anthropological, 3, Hanover-square, W., 8½ p.m.

WEDNESDAY, JUNE 26...SOCIETY OF ARTS, John-street, Adelphi, W.C., 4 p.m. Annual General Meeting.

Royal Society of Literature, 20, Hanover-square, W., 8½ p.m.

British Astronomical, Sion College, Victoria-embankment, E.C., 5 p.m.

THURSDAY, JUNE 27...Royal, Burlington-house, W., 4½ p.m.

Antiquaries, Burlington-house, W., 8½ p.m.

FRIDAY, JUNE 28...East India Association, Caxton-hall, Westminster, S.W., 4 p.m. Mr. J. B. Pennington, "Indian Administration: Suggestions by an Old District Officer."

Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Physical, in the City and Guilds' Central Technical College, Exhibition-road, S.W., 5 p.m. Mr. J. T. Irwin, Demonstration of the uses of his Hot Wire Oscillographs and Hot Wire Wattmeters. 2. Mr. J. S. Dow, "A Cosine Flicker Photometer." 3. Mr. J. S. Dow, "Some Phenomena in Colour Vision." 4. Prof. W. E. Ayrton and Mr. T. Mather, Description and Exhibition of Students' Apparatus for Measuring Permeability and Hysteresis, 5. Prof. W. E. Ayrton and Mr. T. Mather, "Design of Chokers."

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FRIDAY, JUNE 28, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's-park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broad-walk, from 9 to 10 p.m.

The Tropical-house, containing the Giant Water Lily (Victoria Regia), and other interesting tropical plants, will be open to visitors, and will be specially illuminated for the occasion.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A Selection of Music will be performed by the String Band of the Royal Marine Light Infantry (Portsmouth Division) in the Conservatory, and by the Band of H.M. Coldstream Guards in the Gardens, commencing at 9 o'clock.

A "Watteau" Pastoral Play in three acts, entitled "La Marquise," will be performed in the Gardens by Mr. Patrick Kirwan's Idyllic Players, commencing at 9.30 p.m.

A Concert and Entertainment, under the direction of Mr. Patrick Kirwan, will be given in the Club-house at 9.45 and 10.45 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These tickets have now been issued. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

Further particulars as to the musical and other arrangements will be given in the Programmes, which will be distributed on the evening.

PROCEEDINGS OF THE SOCIETY.

ANNUAL GENERAL MEETING.

The Annual General Meeting for receiving the Report of the Council, and the Treasurers' Statement of Receipts and Payments, during the past year, and also for the Election of Officers and New Members, was held, in accordance with the By-laws, on Wednesday last, the 26th inst., at 4 p.m., SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council, in the chair.

The SECRETARY read the notice convening the meeting, and the minutes of the last annual meeting.

The following candidates were proposed, ballotted for, and duly elected members of the Society:—

Alby, Amédée, 80, Boulevard Flandrin, Paris, France.

Bacon, George Morgan, 159, Pierpont-avenue, Salt Lake City, Utah, U.S.A.

Bacon, James Hayward, Engineering Department, Grand Trunk Pacific Railway, Prince Rupert, British Columbia, Canada.
Berquist, A. S., M.Am.Soc.C.E., 1571, 47th Street, Brooklyn, New York, U.S.A.
Bovey, Henry Taylor, M.A., LL.D., F.R.S., M.Inst.C.E., Dean of the Faculty of Applied Science, McGill University, Sunandene, Montreal, Canada.
Bromley, H., George, Cape Colony, South Africa.
Conchie, James, 13A, Porchester-terrace, Hyde-park, W.
Dallas, Arthur, Messrs. Atkinson and Dallas, 4, Peking-road, Shanghai, China.
Desmond, Veterinary-Surgeon J., Adelaide, South Australia.
Dixon, John, 7, Curzon-street, Maryport.
Escudier, John L., 8, Woodstock-road, Chiswick, W.
Gautier, William Lord Albert, Prescott-lodge, Park-hill, Clapham, S.W.
Graham, Walter Armstrong, The Residency, Kelantan, Siamese Malay States.
Harrison, William James, Revenue Cruiser *Chuentiao*, care of Imperial Chinese Customs, Shanghai, China.
Hayakawa, Senkichiro, 69 Nichome, Nagatacho, Kojimachi-len, Tokyo, Japan.
Hepburn, Arthur E., 956, Nicola-street, Vancouver, British Columbia, Canada.
Jervey, Major Henry, U.S. Engineer Office, Mobile, Alabama, U.S.A.
Lindley, William Heerlein, M.Inst.C.E., 29, Blittersdorffsplatz, Frankfurt-am-Main, Germany.
Loveless, Thomas Henry, 76, Harley-street, W.
New Zealand, The Secretary, Education Department, Wellington.
O'Ryan, William, Waipiro Bay, New Zealand.
Osment, Harry Shorthose, care of British Vice-Consul, Lima, Peru, South America.
Pendleton, William B., The Corrimal Balgownie Collieries, Limited, Corrimal, New South Wales, Australia.
Pope, Alfred Atmore, Hill Stead, Farmington, Connecticut, U.S.A.
Powell, Charles, 70, Camden-road, N.W.
Richardson, Harry, The Cottage, Craigie, Broughty Ferry, N.B.
Schlicht, Paul, St. James's-court, Buckingham-gate, S.W.
Sinclair, J. E. Tanjong Pagar Dock Board, Singapore, Straits Settlements.
Singh, Sardar Sahib Ram, Mayo School of Art, Lahore, Punjab, India.
Smith, J. Landreth, Glenfield, St. George's, Grenada, British West Indies.
Stewart, William Thomas, A.M.I.E.E., Central Station, Bodinayakanur P.O., S. India.
Tan Kheam Hock, 85, Cecil-street, Singapore, Straits Settlements.
Tuxford, Ivon, Shanghai-Nanking Railway, Shanghai, China.
Underwood, Edward, Thorndon, Baldock-road, Letchworth, Herts.
Vandeleur, John Frederick Boyle, 3, Dineen-building, Toronto, Canada, and 18, Salisbury-road, Hove, Sussex.
Walsh, Edmund, J., 402, O'Connor-street, Ottawa, Canada
Wyon, Allan G., 2, Langham-chambers, Portland-place, W.

The CHAIRMAN nominated Mr. J. H. Monk and Mr. H. Conradi scrutineers, and declared the ballot open.

The SECRETARY then read the following

REPORT OF COUNCIL.

I.—ORDINARY MEETINGS.

Previous to Christmas there were five Ordinary Meetings. At the first of these—on the 21st November—Sir Steuart Colvin Bayley, the Chairman of the Council, delivered his Opening Address. The subject which Sir Steuart adopted was the History and Work of the Indian Section of the Society. It is now nearly forty years since the Section was founded, the first meeting in connection with it having taken place in February, 1869. Sir Steuart showed how useful the work of the Section had been in disseminating a knowledge of Indian matters, and in educating public opinion by papers and discussions. Believing that the Indian Section had had a fairly useful and successful life, he was not able to suggest any alteration in its constitution, or any method by which its work could be improved. He discountenanced any suggestion that the Section should break off from the parent Society and form a separate association ; but on the other hand he thought that the Section might usefully absorb the other societies now dealing with Indian matters.

At the first meeting after the opening meeting, Mr. John William Gordon read a very valuable paper on "Patent-law Reform." The first part of the paper contained an interesting sketch of the growth of Patent-law in this country, the first country in which any law of the sort was established. Referring to the great Patent Act of 1852, he took occasion to regret that the proposal inferentially contained in it for a full system of Colonial Registration was never carried into effect, the result being that each Colony now has its own Act and its own separate Patents, so that the various divisions of the Empire are now, as regards Patent-law, separate countries,

and an inventor is in the same position with regard to the Colonies as he is with regard to independent countries. Mr. Gordon devoted a large portion of his paper to the very important question of compulsory licenses and compulsory working, and it was these two topics which were principally dealt with in the discussion, and in the adjourned discussion which was held on the 16th of January, the first meeting after Christmas. The opinions expressed certainly varied; but the meeting was practically unanimous as to the necessity for some change in the system which would prevent a foreigner with an English patent from stopping the manufacture in this country, while he developed his invention, and possibly the industry dependent upon it, abroad. Mr. Gordon also spoke rather strongly as to the use of injunctions, and the readiness with which they are now granted by the Courts.

At the third meeting of the session Sir Charles Watson brought forward some of the objections which exist to the compulsory introduction of the Metric System. As a rule the advocates of the Metric System have been by far the most energetic, and most of the papers which have been read on the subject here and elsewhere have been in its favour. This was the case with the last paper on the subject read before the Society of Arts by Mr. A. Sonnenschein in 1903. Sir Charles Watson began with some account of the origin of the system, and dwelt on the discrepancies existing between the system now actually in use, and the theoretical system originally proposed. He also referred to the many difficulties of change, and the serious questions which would arise if the Metric System were to be extended into the textile and other industries. In the discussion both sides were represented. The Chairman—Sir David Gill—is well known as an advocate of the metre, and so of course is Lord Kelvin, who, as he was unable to be present, wrote criticising Sir Charles Watson's paper, and pointing out that in the improbable event of all the existing copies of the standard metre being destroyed, it would be possible to obtain a fresh standard by purely optical methods.

At the next meeting Mr. Cecil Hooper drew attention to the serious injury which is now being done to fruit and other crops by the over-protection of birds in this country. Mr. Hooper is himself a practical fruit-grower, and he produced a great deal of evidence of the very serious damage to fruit crops done by birds. He went very fully into the question, discussing both the harm done, and the assistance rendered, to the farmer by a large number of the commoner birds. Though some of the speakers in the discussion thought that the birds on the whole did as much good as they did harm, the general feeling certainly was that the growth, at all events, of fruit in this country was rendered extremely difficult and unprofitable by the damage done by birds.

At the last meeting before Christmas Mr. Albert Humphries, the President of the Association of Millers, read a most comprehensive and useful paper on "The Modern Developments of Flour-Milling." It is common knowledge that very great alterations have been made in modern methods of manufacturing flour, but what these changes actually are is certainly not generally known, except among experts. Mr. Humphries' paper gave a clear and quite popular description of modern methods. In conclusion, he strongly controverted the notion that modern developments of flour milling were harmful to the consumer, and maintained that the flour produced by the most highly developed machinery had a greater dietetic value than the flour produced by the old-fashioned mill-stones.

As mentioned before, the first meeting after Christmas was devoted to the adjourned discussion on Mr. Gordon's paper on "Patent Law Reform." At the second meeting in January, Monsieur Bunau-Varilla, who was formerly Chief Engineer of the Panama Canal Company, read a most elaborate and valuable paper on the Panama Canal. Mr. Varilla's paper was, throughout, a strong recommendation of what he terms the "Straits of Panama" type as against the "Lock Canal" type. What he advocates is, in fact, a waterway without locks, from the Atlantic to the Pacific, of an average width of 650 feet, about the width of the Thames at low tide at London-bridge. This waterway he proposes to construct almost entirely by means of dredging. To enable the dredgers to get at their work at the higher levels he proposes to dam up the rivers of the isthmus so as to form a lake. This, in addition to bringing the dredgers to their work, would form a dumping ground for the waste material. A certain small proportion, but only a small proportion, at the summit would have to be excavated in the dry, and even here the removed material could be dumped into the lake. The methods by which it is proposed to carry out the work are described in considerable detail in the paper, the estimated

cost of the work is given, and the objections to the scheme are met. It might be added that the paper was written throughout by Monsieur Varilla in English, and read by himself.

At the next meeting Mr. James Parsons gave an account of the successful attempts which have been made in Whitechapel to carry out a system of Apprenticeship. In Mr. Parsons' opinion the Apprenticeship system is by no means really dead, as it is believed to be in many quarters, and he gave an account of the useful work which has been done by the Committee with which he is associated, and also by the Jewish Board of Guardians in keeping alive the old system of Apprenticeship.

The next paper was by Mr. Thomas Young on "The Principles and Practice of Insurance." In recent years a good many developments have taken place in the methods of insurance, especially of life insurance. These new methods were fully discussed by Mr. Young, and much information given of a character likely to be useful to those who are contemplating insurance.

Amongst the many important questions which go to make up the problem of London traffic the use of motor omnibuses is one of the most important, and consequently the paper read on that subject by Lord Montagu of Beaulieu was extremely appropriate and well timed. Lord Montagu is known as a great authority upon motors, and naturally he is strongly in favour of the motor omnibus, both in London and as an adjunct to railway transport in the country. In his view, and his opinion was supported by the Chairman, Mr. Campbell Swinton, the motor omnibus, after a little more experience, will prove to be a cheaper and more valuable means of transport than the tram. The subject is one on which it is difficult to obtain accurate information, since the only persons who possess that information are the directors and managers of the various rival companies, and they are naturally precluded by their interests from publishing it. Lord Montagu's paper was therefore of much practical value.

Of recent years there have been a good many papers and lectures on the production of cold, and its remarkable applications. In his paper on "The Commercial Application of Refrigeration," Mr. Hal Williams brought the subject up to date, and showed how numerous are the applications of cold storage which have been introduced of recent years. Though the preservation of food is still the most important, it is now only one in the long list of industrial uses to which refrigeration is put. Amongst the most remarkable of its applications, if not the more important, was certainly the power which is now given to horticulturists to retard the development of plants by cold, so as to produce flowers or fruit almost at any season of the year.

The subject of Type-writers has received a good deal of attention at the Society of Arts. When the modern type-writer was first being brought into popular use, Mr. John Harrison described the forms of machines which were employed in 1888, while as far back as 1867 Mr. John Pratt described at one of the Ordinary Meetings of the Society the very ingenious writing machine he had invented. The history of the apparatus has also been fully dealt with in the course of Cantor Lectures by Mr. H. C. Jenkins, who traces the origin of the machine as far back as 1714. In the paper which Mr. Arthur E. Morton read in March last on Modern Type-writers, the various machines now in use were fully described, with the numerous detailed additions which have been made to them of recent years. Probably few, except expert typists, know how much can be done by the modern apparatus, especially in the way of copying and keeping accounts, and in varying the colour of the printing.

In his paper on "The Discovery of the South-Eastern Coalfield," Professor Boyd Dawkins gave a very full account of the history of the investigations into the existence of coal in Kent since Godwin-Austen in 1856 suggested the possible extension of the coal seams beneath the south-eastern part of England. He also showed precisely the present condition of the undertaking, and held out good grounds for hope that before very long the coal supplies of the country would be augmented by the coal from the south-eastern field, which he believed to be valuable and workable. This field he considered would probably rank, when fully developed, among the important coal-fields, and cause centres of industry to be established in Kent like those of Liége and Valenciennes.

For some little time past Mr. Noel Heaton has been engaged upon a careful investigation into the character of the stained glass used in mediæval windows, its character, and the causes of its decay. The results of these investigations were given to the Society in an interesting paper read by him, in which he

threw a good deal of light on the technical problems which face the modern glass-painter and glass-maker.

The perennial problem of London smoke was once more treated by Mr. J. B. Kershaw, with special reference to the prevention of smoke in factories and electric supply stations. He urged that the prevention of smoke under such conditions was, with a properly designed plant, entirely possible, and urged that steps should be taken to insist on the application of scientific principles to this branch of industrial practice.

At the first meeting after Easter Mr. Louis Felberman, who has established a well-deserved reputation among his compatriots for the efforts which he has been making, as Acting Vice-President of the Hungarian Society, for making Hungary better known in this country, and developing a good feeling between the two kingdoms, read a paper on "Arts and Industries in Hungary in Ancient and Modern Days," in which he described, in a full and interesting manner, the ancient arts and the modern resources of that great country.

At the next meeting, Major Baden-Powell read a paper on "Aerial Navigation," which was the occasion of the last appearance at the Society of Sir Benjamin Baker, who was in the chair, and whose recent death the Society has so much reason to deplore. The paper dealt entirely with mechanical methods of navigating the air, excluding not only balloons, but navigable airships that relied upon gas for their power of elevation. The author would not admit that the problem of mechanical flight offered any insurmountable difficulty, though it had not yet been solved. With the engines now available all that was wanted was a hull of proper shape and construction. That such a hull would eventually be constructed had, he thought, been shown by the action of small models.

At the following meeting Mr. Herbert Wright gave a valuable and elaborate paper on "Rubber Cultivation in the British Empire." Until lately the whole of the world's supply of rubber was derived from wild trees, but, as is well known, of late years great efforts have been made in almost all parts of the world, suitable for its cultivation, to develop plantations of rubber, and though the proportionate amount of cultivated rubber is still practically insignificant, it is rapidly developing, and may be expected before many more years are passed to rival, if not to overtake, the present wild supplies. Mr. Wright, who spoke from a considerable knowledge and great practical experience of rubber cultivation, dealt with the matter very fully and completely.

At the first meeting in May Mr. Alfred E. Carey dealt with the question of "The Protection of Sea Shores from Erosion," a subject which has for centuries been one of importance to these islands, and is now actually under the consideration of a Royal Commission. Mr. Carey's was a useful, practical paper, dealing with the various methods of protecting the shore, and with the general system of administration which was, in his opinion, required to ensure the security of the whole of our coasts.

Mr. Paul Schlicht in his paper on "The Production of Coke and its Application in Domestic Fires" dealt partly with the same snbject as that already treated by Mr. Kershaw—the Prevention of Smoke—though from another standpoint. Mr. Schlicht's cure for the evil is the use of suitable coke instead of bituminous coal. He described methods for the production of such coke, and also a system which he found effective for burning it in domestic fires.

The last paper of the session was by Dr. Herbert W. G. Macleod on "Trypanosomiasis, or Sleeping Sickness," a disease which, as is well known, has been devastating certain districts of Central Africa. Mr. Macleod dealt with the subject in the only manner suitable for the Society of Arts, where, of course, such purely medical subjects can only be treated in a popular fashion. It is one special provision of the Society to help to form and educate public opinion on such topics. Unless information on such subjects is brought before the general public, it is idle to hope that influence will be brought to bear upon the Government, such as is required to induce them to take the necessary steps for the investigation into the causes of tropical diseases like Trypanosomiasis, and its necessary prevention.

II.—Indian Section.

Unflagging interest continues to be manifested in the transactions of this Section, and since its formation, some forty years ago, it has probably had not had a more successful session than the one just terminated. If more attention is now bestowed by the public at home upon our great Asiatic dependency, and if Indian subjects have to a considerable extent ceased to be "not only insipid, but positively distasteful," the Society of Arts may claim to have done not a little in the bringing about of this

desirable change. An authority on India has recently written :—"The Society fulfils a most useful *rôle* in providing an adequate opportunity for the discussion of Indian problems—often of the highest Imperial interest—before interested and influential audiences."

An occasion of special importance was the meeting at which Sir Frederic Lely read a remarkable paper on the famine in Gujerat, and Lord Curzon of Kedleston presided. His Lordship, when invited to take the chair, replied that though living in the country and in retirement he would, out of regard for Sir F. Lely, accede to the Committee's request, and in opening the meeting Lord Curzon said that he could not resist the invitation, which he almost regarded as a command. Sir Charles Elliott, in 1897, and Mr. Holderness, in 1902, addressed the Society on Famine. Sir Frederic Lely dealt with the subject from a different point of view. "They," he said, "discussed the problems of famine policy as they appear from the watch-tower of the Imperial Government. I essay the humbler task of giving some reminiscences of one who was down below in the thick of the fight." In the course of his paper, so full of eloquence and pathos, as the Chairman described it, the author combated the theory which blames the British *raj* for the recurrence of famine and the disaster it entails. He pointed out that our predecessors in the Government thought so little of famine that they did not take the trouble to record it, but he was able to quote authentic evidence of sixteen famines in one part of India alone—the Presidency of Bombay—between 1770 and 1825. Famine has ever existed in India. It "once meant abandonment of the people, desolation, cannibalism. It now means much distress, much mortality it is true, but also persistent and thoughtful effort to diminish it, approaching by dint of severe experience ever nearer to the ideal when everything shall be foreseen and forestalled." The paper brought out the striking fact that famine was not due to inability to bring grain to the locality, but to want of means of purchasing it when it was brought there. Lord Curzon, in opening an interesting discussion, testified to the truthfulness of Sir F. Lely's picture of the state of things that prevailed during periods of scarcity before England took over the government, and advised those who wish to see what the British Government is capable of doing in India to go there not in prosperous times, but when the land is in the throes of a great famine.

Intimately connected with the subject of Famine is that of Irrigation. In 1896 Sir James Lyall read a paper on "Punjab Irrigation—Ancient and Modern," and more recently Mr. Sidney Preston dealt with the latest developments, particularly the great Chenab Canal scheme. It remained for some one to supplement these valuable contributions by showing exactly how the work of the engineers has been utilised and how, as the result of their splendid achievements, large and thriving communities have been planted on what until a comparatively recent period were vast arid tracts uninhabited except by nomads. Mr. Laurence Robertson, I.C.S., who assisted in the organisation of one of the settlements, consented to prepare such a paper, and this paper under the title "Irrigation Colonies in India," was read before a very appreciative audience on May 30th, the Under-Secretary of State for India, Mr. C. E. Hobhouse, M.P., presiding. The colonies described in Mr. Robertson's excellent paper are three in number—two, the Chenab and the Jhelum, being in the Punjab, and the third, the Jamrao, in Sind. The largest, the Chenab, commands an area of 5,000 square miles and the colonies altogether are equal in extent to the whole of the culturable area in Egypt. In 1905-6 canal water was supplied to over 2½ million acres, and Mr. Robertson estimates the value of the crop raised at nearly 6 millions sterling, almost double the gross capital cost of the systems. Agricultural land which at the beginning of operations on the Chenab fetched under £3 an acre now sells for £20 or £30. The progress of most of the towns in the colonies has been rapid. When the last census was taken, in 1901, Lyallpur had a population of over 10,000, although the town had no existence six years before. Communications, however, are not yet quite satisfactory and Mr. Robertson recommends the construction of light feeder railways. The suggestion is supported by Sir Thomas Higham, who thinks such railways likely to be very remunerative. An exceptionally interesting discussion followed the reading of Mr. Robertson's paper, the speakers being Sir Evan James, Sir Frederic Lely, Mr. H. S. Lawrence, I.C.S., Mr. T. W. Holderness, Mr. T. H. Thornton, and the following engineering authorities :—Mr. J. S. Beresford, C.I.E., Mr. R. B. Buckley, C.S.I., and Colonel Sir Colin Scott-Moncrieff.

An analogous subject was ably dealt with at an earlier meeting by Sir Edward C. Buck, late head of the Agricultural Department in

India. In 1906 he was charged by Lord Minto's Government with a mission to visit Italy to report upon the methods by which river silt is so successfully and extensively utilised in that country for the fertilization of previously sterile tracts, and for the prevention of malaria. In his paper Sir Edward set forth the results of his exhaustive investigations and discussed the possible application of Italy's "grand object-lesson" to India. He took for his text a resolution of the Agricultural Conference held at Ravenna three years ago, "that wherever fertilizing silt is available it is a grave economical error not to profit by it," and he sought to demonstrate that in no country is the application of that proposition more needed than in India. In the discussion that followed a general desire was expressed for further inquiry by the Indian authorities.

Not the least valuable of the series of papers on the provinces and capitals of India was contributed by Sir James Thomson, whose subject was the city of Madras, on whose charms the Chairman of the meeting (Lord Ampthill) and Sir Philip Hutchins also spoke with enthusiasm. The third city in India and the seventh in the whole Empire—the marvel of Madras to Sir J. Thomson is that with so little granted by natural position so much has been accomplished. "Madras has no mighty river flowing past, no supremely fertile soil adjacent, no splendid bay, no hills to look up to or from." But, as the author indicated, her development is happily unhindered by circumstances that make government a less easy matter in other centres of British power in the peninsula.

An admirable paper by Mr. A. Yusuf Ali, I C.S., on the Indian Mohammedans, was the first of a course on the peoples of India, and it is hoped that so far as the principal races are concerned the authors will in each case be members of those races. The scope of Mr. Yusuf Ali's paper is shown by the following passage:—"It is certain that an imperfect appreciation of the Indian Mohammedans is at the bottom of much of the misunderstanding that exists between them and the English, and between them and their Hindu fellow-subjects. Let us see if we can briefly review their past history, their present position, and their future prospects. In doing so let us hold in view not so much a narration of events as an appreciation of the moral factors which have made the Indian Mohammedans what they are, and which will doubtless operate in their attitude to future events." Although a minority of the population (they number 62½ millions) they are increasing faster than the Hindus, and Mr. Yusuf Ali holds that "if they have any consciousness of moral worth, their influence is, or might be, greater than can be measured by mere numbers." Their chief requirements were shown to be organisation and self-help.

The "Bhils of Western India" formed the subject of a picturesque paper by Captain E. Barnes, who, while serving in the "Bhil country" as an officer of the Political Department, made a careful study of the customs and habits of this interesting and attractive but backward and more or less wild race. Animistic in religion, they number, according to the last census, 1,200,000 souls, are averse from all forms of manual labour, but make good soldiers, and are gradually being brought under the influence not only of Hinduism and Mohammedanism but of Christianity. Captain Barnes expresses the opinion that with sympathetic treatment, and a careful regard to their home prejudices, they should eventually develop into a more settled community.

III.—Colonial Section.

The session opened in December, when, before a crowded and distinguished audience and under the presidency of Viscount Milner, the Hon. Sir Lewis Michell impressively discoursed on the aims and objects of the most ambitious of Mr. Cecil Rhodes's schemes, the Cape to Cairo Railway, as originally projected. The undertaking, Sir Lewis declared, is no unsubstantial dream but a reality, possibly in advance of its age but still a reality, and already in great part an accomplished fact. From Cairo or Alexandria southward to Assuan, a distance of 590 miles, the line, he announced, is constructed, and another 560 miles between Wady Halfa and Khartum, while a further extension of 410 miles to Usambara is projected. In the aggregate, the line from the north, completed or contemplated, is thus about 1,600 miles, and from the south rather more than 2,000 miles. Add to this the long Tanganyika waterway, and it will be seen that the great enterprise is already far advanced. Sir Lewis expressed confidence in the ultimate completion of Mr. Rhodes's splendid idea, and the Chairman was equally sanguine though he admitted that there "might be some delay, even considerable delay," in joining up the two ends of the line. But, he added, long before those two ends were joined, the existing portions (and he was speaking more especially of the South

African portion) would have fully justified all the great efforts which had been made to create them. Among those who took part in the discussion were Sir David Gill and Sir Douglas Fox.

Mr. George Wilson, C.B., Deputy-Commissioner of Uganda, read a reasoned and elaborate paper on the wonderful progress, moral and material, made by that Protectorate since Sir Frederick Lugard, rather less than seven years ago, received orders to proceed to the country and make a treaty with its inhabitants preparatory to the establishment of British control. Sir Fredérick Lugard, who presided over the meeting, delivered a notable speech, in which he claimed that the advance made in Uganda since his time is a proof of the ability of our race to meet what he thinks is the great question of the twentieth century, namely, the development of the tropics not only for the advantage of the native inhabitants but for supplying the increasing demands of European manufacturers for raw materials. Both Mr. Wilson and Sir F. Lugard bore ungrudging testimony to the "enormous work," as the latter called it, performed by the Mission Agencies, especially in regard to education, and Bishop Tucker, who also took part in the discussion, mentioned that he was actually looking forward to the establishment in the not distant future of a University in Uganda.

Under the title of "British Malaya," Sir William Hood Treacher read an excellent paper on a most interesting but not sufficiently well known part of the Empire, the countries enumerated in his survey comprising roughly an area of 351,600 square miles, and containing a population of some 12½ millions. Our marked success in governing British Malaya and the notable absence of discontent are attributed by the author chiefly to the sympathetic attitude of European officials towards the natives and to a generous expenditure on public works, roads and railways. The value of the paper was enhanced by the inclusion of some exhaustive ethnological notes by Mr. Walter W. Skeat, and by a useful description of the geological features of the Malay Peninsula from the pen of Mr. John Fordyce Balfour.

At the concluding meeting the Hon. John Winthrop Hackett addressed the Section on "Social and Economic Conditions in Australia," mentioning, amongst other interesting facts, that the Australian Commonwealth comprises more than 35 per cent. of the territory constituting the British Empire, and that with 97 per cent. of its inhabitants of English, Scotch and Irish descent it is "the most purely British portion of the Empire outside the Motherland." The Hon. Alfred Deakin presided, and made an excellent speech touching on the future of Australia. The Hon. W. M. Hughes, one of the leaders of the Australian Labour Party and an ex-Minister, also contributed to the discussion.

IV.—Applied Art Section.

The first meeting of the Section was held on December 18, when an instructive paper on "Basket Making" was read by Mr. Thomas Okey, who (himself a practical basket maker) was able to describe fully the technical points connected with one of the oldest of the arts. So little have these changed that the same "strokes" found in the oldest baskets discovered in the ancient Egyptian tombs are in use at the present time.

At the next meeting, on January 29, Mr. William Dale read an interesting paper on "The Artistic Treatment of the Exterior of the Pianoforte," in which he described some of the most remarkable examples of ornamented harpsichords and pianos, paying special attention to the beautiful modern instruments designed by Sir Lawrence Alma Tadema, R.A., Sir Edward Burne Jones, and the Chairman (Mr. T. G. Jackson, R.A.). Mr. Dale pointed out that improvements might be made in the form and decoration of the ordinary upright pianoforte without any great increase in its price. In the discussion attention was directed to the sound principle that the form of the case, however altered, should always follow the main lines of the instrument.

Dr. A. P. Laurie's important paper read at the third meeting—"Oils, Varnishes, and Mediums, used in the Painting of Pictures," was a complement to Prof. J. M. Thomson's paper on "Artists' Pigments," read last session. The author described his original experiments on this subject, and illustrated his paper with a valuable series of microphotographs. Sir Luke Fildes, R.A., presided at the meeting, and in the discussion the hope was expressed by the artists present that the further experiments on which Dr. Laurie was engaged would throw more light on the actual cause of the cracking of pictures.

Mr. A. Romney Green's paper on "Joinery and Furniture Making," read on April 16, contained a history of the art of joinery and a demonstration of the superiority of the older furniture by reason of the use in its construc-

tion of simpler tools than those afterwards introduced. The author drew special attention to the importance of the proper cutting of timber for the production of sound planks. The paper was illustrated by examples of old furniture from the Victoria and Albert Museum, lent by the Board of Education.

Mr. William Burton's paper on "Lustre Pottery" consisted of a brilliant exposition of the history of the changes in character of lustre from its origin, and the advances which had been made in the manufacture, especially in the case of the beautiful ware with its remarkable iridescence now made by Pilkington's Tile and Pottery Company. A singularly fine collection of historical and modern pieces from the Victoria and Albert Museum, and many other contributors, was exhibited.

At the last meeting of the session, on May 28, Mr. Sherard Cowper-Coles read an interesting paper on "Sheffield Plate and Electro-Plate," in which he traced the history of plating in metal from its practice before the introduction of Sheffield plate, which itself has been superseded by electro-plate. The Chairman (Sir John Edward Bingham), from his great experience of the subject, was able to supplement the information given in the paper, and an important discussion was the result.

V.—Cantor Lectures.

The first of the courses of Cantor Lectures during the present session was on "Artificial Fertilisers," by Mr. A. D. Hall, the Director of the Rothamsted Experimental Station under the Lawes Agricultural Trust. Mr. Hall's course was of an extremely valuable character and was well attended, though the subject is suited rather for a country than for a London audience. His first lecture was devoted to the consideration of the nutrition of the plant itself, and in it he showed that practically all the elements required for plant life were nitrogen, phosphoric acid, potash, lime, and magnesia, the first three being much the most important. The remaining four lectures of the course were consequently devoted to these three materials—two to nitrogen, one to phosphates, and the last to potash. In the two devoted to nitrogen, the first dealt mainly with the fixation of nitrogen and its supply to the plant; the second with the sources and character of nitrogenous manures. Up to the present time the source of supply of nitrogen has practically been found in the Chilian deposits of nitrate of soda. Attention has lately been drawn by Sir William Crookes, amongst others, to the question of the supply of nitrogen to plants after the Chilian and other supplementary deposits have been exhausted, and attempts, as is well known, have lately been made to obtain the nitrogen of the atmosphere in a form suitable for the manufacture of manures, and at a cost which would enable the artificial product to compete with the natural one. There are two methods of bringing the free natural gas into combination—the first by causing it to combine with oxygen to form nitric acid, and eventually nitrate of calcium; the second by causing it to combine with such a material as calcium carbide to produce calcium cyanamide, which will decompose under the action of water and yield its nitrogen as ammonia. This method is now being carried out on a commercial scale, and with considerable success. The production of nitrate of lime is also now running on a commercial scale, and, so far as the use of the manure goes, with perfect success. Mr. Hall found that chemically prepared nitrate of lime gave practically equivalent results when tested on a plot at Rothamsted to those obtained with a nitrate of soda crop alongside. The various phosphatic fertilisers were dealt with in the fourth lecture, natural phosphates, superphosphate from mineral phosphates, basic slag, resulting from the Thomas-Gilchrist basic process of steel making, &c. Potassic fertilisers formed the special subject of the fifth lecture, in concluding which Mr. Hall gave some useful advice to farmers as to the use of artificial fertilisers. He maintained that if the manure now used were more carefully bought, and more skilfully adjusted to soil and crop, the greater profit would justify an increased purchase of such materials, and a larger fertiliser bill on the part of the farmer.

The second course of lectures was by Professor J. W. Gregory, on "Gold Mining and Gold Production." The general object of the course was to afford the numerous class of people who are now interested, principally for financial reasons, in gold mining, but have no special knowledge of the subject, an opportunity of acquiring such information. The lectures, therefore, were of a popular rather than of a technical character, although there was much in them likely to be of use even to persons technically employed in gold mining. The first lecture dealt principally with alluvial gold mining, now to so large an extent a thing of the past. The second lecture treated of

lode mining, that is to say what is now generally known as gold mining. The chief goldfields of the world were referred to, and their structure described. The production of the gold, the crushing of the ore, and the extraction of the metal itself, formed the subject of the third lecture.

In the third course of the Session, Mr. F. Hamilton Jackson dealt with "Romanesque Ornament," and to this subject he devoted three lectures. The course was in fact a comprehensive treatment of a large and difficult subject. The lectures were illustrated by a beautiful and original series of lantern slides of specimens of ornament taken from buildings in all parts of Europe. The author described the cloister as the cradle of Romanesque, and referred to the universality of the appearance of similar designs in the various arts of architecture, miniature painting, textiles, ivory carving, &c. He laid special stress on the Oriental influence exerted on ornament in France and Italy. These lectures, as containing original examples of a great variety of Romanesque ornament, will help students to a clearer understanding of some of the difficulties presented in the history of this subject.

The last course of lectures was by Professor Herbert Jackson on the subject of "Detergents and Bleaching Agents used in Laundry Work." This important subject, though it certainly deals with a London industry of very considerable extent, has never before been made the subject of a course of Cantor lectures. Of the three lectures of the course, the first was devoted mainly to water and soap. The softening of water for laundry work was referred to, and easy methods were described for examining the value of soaps. The second lecture was devoted to bleaching agents, their composition, methods of application, value, &c. The third lecture was perhaps the most important, as it dealt with the whole question of washing fabrics, and their destruction by some of the methods used in modern laundry work. On the whole, Professor Jackson attributed the injury to fabrics now so much complained of rather to alterations in the fabrics themselves than to the use of improper agents for washing.

VI.—Juvenile Lectures.

The usual short course of Christmas lectures intended for a juvenile audience was delivered this year by Mr. Bennett H. Brough, the Secretary of the Iron and Steel Institute, who took for his subject "Perils and Adventures Underground."

After a brief sketch of the amount and importance of mining in every country of the world, and especially in great Britain, Mr. Brough passed on to a consideration of the dangers with which miners had to contend in every period. The old miner did not recognise the source of his dangers, and attributed them to various malignant influences But the modern miner, in spite of the advance of science, and the knowledge which had been gained, had to contend with the same difficulties, and on a larger scale. What these dangers were—fires, explosions, falls of roof, accidents in haulage operations and in machinery, inundations, and fire-damp—were all described, and the various methods which had been devised for minimising them, securing safety to the miner, and rescuing him after a catastrophe had happened.

VII.—Albert Medal.

The Council of the Society, with the approval of His Royal Highness the President, the Prince of Wales, have awarded the Albert Medal for the current year to the Earl of Cromer, O.M., G.C.B., G.C.M.G., K.C.S.I., C.I.E., "In recognition of his preëminent public services in Egypt, where he has imparted security to the relations of this country with the East, has established justice, restored order and prosperity, and, by the initiation of great works, has opened up new fields for enterprise."

Lord Cromer more than any other man, has opened up Egypt and the Sudan to arts, industries, and commerce. For architects, engineers, and merchants, he has secured a wide and widening field. Lancashire spinners owe him a practically new source of supply of cotton, and manufacturers and users of India rubber will soon have to thank him for additional supplies of that article.

To him commerce owes the new facilities for discharging and loading cargoes at Alexandria, which are making that place one of the finest ports, if not the finest port, in the Mediterranean. It also owes to him an improved lighthouse service.

He did more than any one to bring about penny postage between this country and Egypt and the Sudan, and he helped to get the charge for telegrams reduced to a shilling.

The irrigation works, which his management of affairs has made possible, are converting deserts into fields and gardens, and

promise, in a few years, to afford means of living to large populations who are sure to make demands on industries and commerce, if not on arts.

But, above all, he has preserved to this country her connection with India and Australia, and her commerce with the Far East, by way of the Mediterranean, which must still remain the highway, however great may be the development of an alternative western route by way of Canada and the Pacific.

VIII.—MEDALS.

The Council have awarded the Society's Silver Medal to the following readers of Papers during the Session 1906-7 :—

At the Ordinary Meetings :—

To Mr. JOHN WILLIAM GORDON, for his paper on "Patent Law Reform."

To COLONEL SIR CHARLES M. WATSON, K.C.M.G., C.B., for his paper on "Some Objections to the Compulsory Introduction of the Metric System."

To Mr. ALBERT E. HUMPHRIES, for his paper on "Modern Developments of Flour-Milling."

To M. PHILIPPE BUNAU-VARILLA, for his paper on "The Panama Canal—the 'Lock Canal' type and the 'Straits of Panama' type."

To Mr. ARTHUR E. MORTON, for his paper on "Modern Type-writers and Accessories."

To Mr. NOEL HEATON, B.Sc., for his paper on "Mediæval Stained Glass, its Production and Decay."

To Mr. HERBERT WRIGHT, for his paper on "Rubber Cultivation in the British Empire."

To Mr. ALFRED EDWARD CAREY, M.Inst.C.E., for his paper on "The Protection of Sea Shores from Erosion."

In the Indian Section :—

To Mr. A. YUSUF-ALI, M.A., LL.M., Cantab., I.C.S., for his paper on "The Indian Mohammedans: their Past, Present, and Future."

To CAPTAIN E. BARNES, for his paper on "The Bhils of Western India."

To SIR FREDERIC S. P. LELY, K.C.I.E., C.S.I., for his paper on "The Practical Side of Famine in India."

To Mr. LAURENCE ROBERTSON, I.C.S., for his paper on "Irrigation Colonies in India."

In the Colonial Section :—

To Mr. GEORGE WILSON, C.B., for his paper on "The Progress of the Uganda Protectorate."

To HON. JOHN WINTHROP HACKETT, LL.D., for his paper on "Social and Economic Conditions in Australia."

In the Applied Art Section :—

To Mr. THOMAS OKEY, for his paper on "Basket Making."

To Mr. WILLIAM DALE, F.S.A., for his paper on "Artistic Treatment of the Exterior of the Pianoforte."

Of recent years it has been the practice that no medal should be awarded to readers of papers who had previously received medals from the Society. Acting on this rule the Council were precluded from considering the following papers :—In the Ordinary Meetings the paper by Major B. F. S. Baden-Powell on "Aerial Navigation." In the Indian Section, the paper by Sir Edward Charles Buck, K.C.S.I., LL.D., on "The Applicability to India of the Italian Methods of Utilizing Silt." In the Applied Art Section, the paper by Principal Arthur P. Laurie, M.A., D.Sc., F.R.S.E., on "Oils, Varnishes and Mediums used in the Painting of Pictures," and that by Mr. William Burton on "Lustre Pottery."

The Council, however, desire to express their high appreciation of these papers by thanking their authors for them.

The Council have always felt themselves precluded from awarding medals to members of their own body, and they, therefore, could not offer one to Sir William Hood Treacher, K.C.M.G., M.A., for his paper on "British Malaya." But they had much pleasure in recording their sense of the value of the paper by passing a special vote of thanks to its author.

IX.—INDUSTRIAL HYGIENE.

In February last the Council announced the offer, under the terms of the Benjamin Shaw Trust, of a Gold Medal, or a prize of £20, for improvements in industrial hygiene.* The Medal, under the conditions laid down by the donor, who died in 1877, is to be given, "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means." Intending competitors are invited to send in descriptions of their inventions not later than the 31st December next. The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the judges nothing deserving the full award is sent in.

On several occasions when the prize has been offered, it has not been awarded, in consequence of the judges being unable to recom-

* See *Journal*, vol. lv., p. 323, Feb. 8, 1907.

mend any invention deserving it. The fund, consequently, has accumulated, and the Council now propose to devote the surplus to the provision of a course of lectures on "Industrial Hygiene," to be delivered some time next session. As soon as the necessary arrangements have been completed, particulars will be given in the *Journal*. The Council feel sure that this proposal would be in accordance with the wishes of the donor, since in 1876 he gave the Society a sum of £50 to cover the expenses of a course of lectures on "Unhealthy Trades," which were delivered by Dr. (afterwards Sir) Benjamin Richardson in that year.*

X.—Mulready Prize.

After the death of Mulready, in 1863, a fund was formed to establish a memorial to him. Sir Henry Cole was treasurer of this fund. The greater part of it was expended in erecting a monument over Mulready's grave in Kensal-green Cemetery. The balance, £109, was presented to the Society of Arts with the view of a Mulready Medal being presented occasionally to the student who should exhibit the best drawing from the nude at the annual examinations of the Education Department.

The Medal has been awarded on several occasions, the last occasion being in 1903. It is proposed to offer it again for competition amongst students of Schools of Art in the United Kingdom, at the annual competition to be held next year.

A gold medal, or a prize of £20, will therefore be offered to the student who obtains the highest awards in the following subjects:—

(*a*.) A finished drawing of imperial size from the nude living model.

(*b*.) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses.

(*c*.) A set of studies of hands and feet from the living model.

(*d*.) Drawing from the life, including memory life drawing done at the Examination in May, 1908.†

XI.—Stock Prize.

In 1871 John Stock left £100 Consols to the Society, with the condition that the interest should be applied for the promotion of drawing, sculpture, and architecture. From time to time, as the accumulated funds permitted, prizes have been awarded under the Trust. In 1893 and again in 1897 prizes were offered to students in Schools of Art for architectural designs. A Gold Medal, or a prize of £20, is now offered* for competition among the students of the Schools of Art at the annual competition of 1908. The prize is offered for the best original design for an architectural decoration (to be carried out in painting, stucco, or any other process), for the side of a room or a hall, a ceiling, the apse or side of the chancel of a church, or any suitable part of the interior of a building.

XII.—Owen Jones Prizes.

After the death, in 1874, of Owen Jones, a committee was formed to collect subscriptions for the purpose of founding a memorial. The money thus obtained was partly expended in erecting a monument over his grave in Kensal Green, and the balance (a sum of £400) was presented to the Council of the Society of Arts upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in actual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes have now been awarded annually since the year 1878 on the results of the annual competition of the Board of Education.

Six prizes were awarded this session, each prize consisting, in accordance with the regulations laid down for the administration of the Trust, of a bound copy of Owen Jones's "Principles of Design," and a Bronze Medal.

The list of the successful candidates has already appeared in the *Journal*.†

The next award will be made this summer, on the result of the present year's examinations. Six prizes have again been offered for competition.

XIII.—North London Exhibition Trust.

In 1865 the Committee of the North London Working Classes and Industrial Exhibition (1864) presented to the Society of Arts a sum of £157, the balance of the surplus from that exhibition, with a view to the award annually of prizes for the best specimens of skilled workmanship exhibited at the Art Workmanship Competitions of the Society of Arts. The Art

* See *Journal*, vol. xxiv., p. 116, Jan. 7. 1876.

† Further particulars of the conditions of the award will be found in the *Journal* for April 12, 1907. vol. lv. p. 575.

* Particulars of the offer will be found in the *Journal* for April 12, 1907, vol. lv, p. 575.

† See *Journal* for Sept. 14, 1906, vol. liv., p. 989.

Workmanship Competitions were discontinued after 1870, but since that date various prizes have been awarded under this Trust. Prizes were offered to the students of the Artistic Crafts Department of the Northampton Institute, Clerkenwell, in 1903, and have been continued annually to the present time. The results of the award for last year were announced in the *Journal* last November.* The offer has been renewed for the current year, but, as the accumulated funds are now nearly exhausted, notice has been given to the Governing Body of the Institute that after the present year the arrangement will have to be reconsidered.

XIV.—Fothergill Trust.

The Council have had their attention drawn to the need which exists for some rescue apparatus which would enable a succouring party to reach men cut off—in case of mining accidents—by irrespirable gases, or suffocated by them. Many such appliances exist, but it does not appear to have been decided which of them are the best, or even which are of practical use.

Under these circumstances they believe that a useful purpose would be served by the offer of a prize for the best life-saving apparatus for use in noxious atmospheres, and they have therefore determined to offer under the Fothergill Trust, a Gold Medal, or a prize of £20, for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious. It is intended that the apparatus sent in shall be submitted to practical trials and tests. The time and conditions of these will be announced later on.

Inventors intending to compete have been invited to send descriptions of their inventions not later than 31st March, 1908. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given. Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The prize will be awarded under the usual conditions on the report of judges appointed by the Council.† The competition is not limited to British subjects.

* See *Journal*, vol. lv., p. 215, November 30, 1906.

† Further details were given in last week's *Journal*, p. 802, vol. lv., June 21, 1907.

Dr. Anthony Fothergill died in London in 1813. He was an M.D. of Edinburgh, and after studying medicine at Leyden and Paris he settled as a physician in Northampton. He also practised in London and afterwards in Bath, where, according to the Dictionary of National Biography, he acquired a large and lucrative practice. In 1803 he retired from active life and went to Philadelphia. He returned to England the year before his death in 1812. He left a considerable fortune, most of which was distributed among various charitable and other institutions in London, Bath, and Philadelphia. The bequest to the Society was left to be dealt with at the Society's discretion in providing medals or premiums, but the subjects suggested for the consideration of the Society in the first instance all related to the protection of life from fire.

XV.—Aldred Lecture.

In 1868, Dr. Aldred left a sum of £100 to the Society of Arts, in order that the interest might provide annually a £5 prize for an essay on some scientific or literary subject. The actual amount of the bequest (£90) was invested in Reduced Three per Cents—£97 16s. 6d. The interest on this was obviously insufficient to provide an annual prize of £5, and the Council consequently determined, in 1883, to allow the money to accumulate until there was sufficient to provide an annual sum of £5. By the year 1902, the accumulation had become sufficient for the purpose, and at the present time there is an available surplus.

Having regard to the unsatisfactory results generally obtained by the offer of prizes for Essays, the Council considered that the wisest course to pursue would be to invite some scientific or literary man of eminence to deliver a lecture before the Society on some subject upon which he was recognised as an authority. They are pleased to be able to say that Sir William Ramsay has undertaken to deliver during the autumn the first Aldred Lecture; the subject selected will be connected with Radio-active Phenomena. The Council hope that they may be able to continue the series of Aldred lectures either annually or biennially, as the funds may permit.

The testator, Dr. George Edward Aldred, died in 1868. He was elected a member of the Society in 1862. He served with Her Majesty's army in India, was an M.D. of Paris 1841, became a member of the Royal College of Surgeons in 1843, and was made a Fellow in 1859. At the time of his death he

was resident in London. He bequeathed nearly all his property amongst public charities, mostly medical.

XVI.—Prizes for Drawing.

Since 1889, the Council have annually placed at the disposal of the Royal Drawing Society, for competition among the candidates at its annual examination, 12 Bronze Medals, and these medals were awarded for drawings sent in by students to the exhibition held by the Drawing Society in April last.

XVII.—Examinations.

In former years it was the practice to include in the Annual Report a full report of the results of the Examinations. The number of candinates entering for the Society's examinations is now so large, and the additional work involved by the addition of the Advanced Stage so considerable, that this is not now possible. A separate supplementary report on the examination of 1906 was published in the *Journal* of October 12th last after the results of the three stages had all been issued, and it is proposed to follow the same plan for this year. It is hoped to publish the results of Stage III., Advanced, early next month; of Stage II., Intermediate, at the end of July; and of Stage I., Elementary, in August.

The total number of papers worked was 24,568, the number last year being 24,179. These were divided among the various Stages as follows: — Stage I., 8,951; Stage II., 10,802; Stage III., 4,815. The corresponding figures for 1906 were—Stage I., 8,536; Stage II., 10,738; Stage III., 4,905. It will be seen therefore that there was a slight increase in Stages I. and II., and a decrease in Stage III.

The Council do not contemplate any modifications in the system next year, as it seems to work with perfect smoothness and to give general satisfaction to all concerned.

At the request of the Army Council, the Council have arranged to hold a special annual Examination in Shorthand for soldiers. The first Examination was held on March 27th, at twenty-three centres in the United Kingdom, one in India, and two in South Africa. In the Advanced Stage (speed 140 and 120 words per minute), there were 8 candidates, of whom 3 obtained 2nd Class Certificates, and 5 failed. In the Intermediate Stage (100 and 80 words per minute) 32 candidates presented themselves, of whom 14 obtained 1st Class Certificates, 9 2nd Class Certificates, and 9 failed. A similar Examination has been arranged in Type-writing to commence next year.

XVIII.—Viva Voce Examinations in Modern Languages.

Up to the present date 10 examinations have been held this year in London, Guernsey, and Manchester. Arrangements have also been made for holding examinations at several other centres.

At these examinations 280 candidates presented themselves, of whom 209 passed (34 with distinction) and 71 failed. The languages taken up were French, German, and Spanish.

The results of previous years are as follows:—

Year.	Number Examined.	Passed	Failed.
1902	280	202	78
1903	456	324	132
1904	540	375	165
1905	681	502	179
1906	644	469	175

These examinations are held at any of the Society's centres where the necessary arrangements can be made. They are held at any date convenient to the local committee. The examination includes dictation, reading, and conversation, and the examination is so arranged as to test efficiency in a colloquial knowledge of the language, without laying too much stress on minute grammatical accuracy. Candidates who are reported upon as highly qualified by the examiners, receive a certificate of having passed with distinction.

The examiners are Mr. E. L. Naftel for French, Professor H. G. Atkins for German, Professor Ramirez for Spanish, and Mr. Luigi Ricci for Italian.

The numbers this year, when all the examinations are finished, are not likely to show any considerable increase on 1906.

XIX—Practical Examinations in Music, 1906.

The practical examinations in Music were not concluded last year until the 5th July, too late for the results to be included in the Report of the Council. They lasted for 13 days.

The examinations were conducted by Dr. Ernest Walker, M.A., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined

in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 477 candidates entered, and of these 467 were examined, an increase of 49 as compared with the previous year. There were 394 passes and 73 failures.

The following were the subjects taken up:—Piano, singing, violin, violoncello, viola, and bassoon. 383 entered for the piano, 320 of whom passed; 57 entered for the violin, of whom 48 passed; 6 entered for the violoncello, all of whom passed; 18 entered for singing, of whom 17 passed; two entered and passed for the viola, and one for the bassoon. No medals were awarded.

XX.—Practical Examinations in Music, 1907.

The Practical Examinations for the present year have not yet been concluded. They commenced on Monday, June 24th. They will be finished on July 10th, after which a summary of the results will be given in the *Journal*. The work of the examination is being carried out by the same examiners as in the last six years. 462 candidates have entered for the present examinations, a decrease on last year of 15.

XXI.—Soane Museum.

Under the Act by which the affairs of the Soane Museum are regulated, the Society of Arts have to nominate one of the trustees. The office is held for five years, and the last election having been in 1902, it is necessary that the Society should exercise its power during the present year. The Council recommend for election Sir George Birdwood, who has acted for the previous ten years, having been elected in 1902, and again in 1907.

In 1833 Sir John Soane presented to the nation the house which he had built in Lincoln's-inn-fields, and in which he had placed his very valuable collections of pictures and objects of antiquarian interest together with his extensive library. At the same time he obtained an Act of Parliament by which the property was vested in Trustees—four appointed by himself, and five by the Corporation of London, the Royal Academy, the Royal Society, the Society of Antiquaries, and the Society of Arts—the four original nominated Trustees having the power to fill up by election vacancies in their number as they occurred. The authority of all the Trustees is the same, but the property is vested in the Life Trustees, and they only have the power of signing cheques. Sir John Soane also provided the funds necessary for the maintenance of the house as a Museum. He died on the 20th of January, 1837, and shortly afterwards the Museum was placed under the authority of the Trustees.

The following is a list of the Trustees appointed by the Society of Arts:—

1837 to 1843—H.R.H. the Duke of Sussex, President of the Society.
1844 to 1857—H.R.H. the Prince Consort, President of the Society.
1857 to 1864—Sir Charles Wentworth Dilke, Bart.
1865 to 1876—Samuel Redgrave.
1876 to 1882—Alan S. Cole, C.B.
1882 to 1896—Sir Benjamin Ward Richardson, M.D., F.R.S.
1897 to 1907—Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.

XXII.—Deterioration of Paper.

In 1898 a Committee of the Society of Arts reported on the question of the deterioration of paper. This report specified certain standards, in which an endeavour was made to maintain a technical ideal. It also called attention to the question of permanence in relation to documents of value, and more particularly books.

The report has certainly had some effect, if only in making known the opinions expressed by competent authorities, but the Society has been reminded afresh that a large proportion of books are still being produced on perishable papers. This is due more particularly to the growing popularity of photographic reproductions, and the necessity of adapting papers to the requirements of the "process" block, and the dominant demand for cheapness.

The chief offender is the imitation art paper, heavily loaded with clay, and calendered so as to produce surface at the expense of the substance of the paper.

These, and other questions, are once more pressed on the notice of the Society, and with the object of again drawing public attention to the question, the Council have re-appointed the Committee. They hope that its report when published may contribute to a sounder public opinion on this very important question.

XXIII.—Honorary Royal Members.

On the occasion of His Majesty the King of Norway's visit to this country in October last, the Council, under the provision of the By-law authorising them to elect every year a certain number of life members of the Society, elected His Majesty an honorary life member; and this month they were able to take a similar course when His Majesty the King of Denmark was in England. In both cases the election was made with the full approval of His Royal Highness the President, who communicated Their election to Their Majesties.

Besides these latest additions to the list, the list of honorary Royal members now includes the King of the Belgians (1876), the King of Greece (1906), the King of Portugal (1906), the King of Spain (1905), and the King of Sweden (1876).

XXIV.—Bicentenary of Linnæus.

At the end of May the Royal Swedish Academy of Sciences, Stockholm, and the University of Upsala, celebrated the Bicentenary of the birth of Linnæus. The Society of Arts was invited by both bodies to send a Delegate, and Professor Hjalmar Sjögren, Professor of Geology in the Mineralogical Department of the Riks Museum, Stockholm, was good enough to accede to the request of the Council that he would act as the Society's Representative on this occasion. Professor Sjögren is a life member of the Society, he having been elected in 1904. The Universities of Oxford and Cambridge, the Royal Society, the Linnean Society, and several other British Institutions were also represented.

XXV.—Conversazione.

The Society's annual Conversazione for 1906 was held on the 3rd July, at the gardens of the Royal Botanic Society. The arrangements were the same as of recent years and the attendance was above the average. This year's Conversazione will be at the same place on the 9th of next month. This is the seventh year in succession for which the gardens have been placed at the disposition of the Society of Arts. The Council trust that the coming Conversazione may be as popular and as successful as its predecessors, all of which appear to have been well appreciated by the members.

XXVI.—New Council.

On the Balloting List presented to the Members in accordance with the By-Laws, by the Council, there are six newly nominated Vice-Presidents, the number having been increased by the unexpected death of Sir Benjamin Baker. The other retiring Vice-Presidents are Sir Owen Tudor Burne, Mr. Lewis F. Day, Sir William Lee-Warner, the Earl of Onslow, and Sir Marcus Samuel. In their places the Council propose Sir Steuart Colvin Bayley and Sir Aston Webb—both of whom were Ordinary Members of Council last year—and Mr. Carmichael Thomas, who has acted most efficiently since 1902 as one of the Society's treasurers. They also propose Sir William Abney, who was Chairman of the Council from 1903 to 1905, and Colonel Holden, who served on the Council from 1904 to 1906. They have also nominated Sir William Thomas Lewis, who has not acted in any capacity on the Council before, but whose name will be well known to the members as one of our greatest authorities on matters connected with coal and coal mining.

As usual four Ordinary Members of Council retire, their names this year being Sir David Barr, Sir Steuart Colvin Bayley, Professor J. M. Thomson, and Sir Aston Webb. In their places the Council recommend Sir Walter Prideaux and Mr. Henry Hardinge Cunynghame—both of whom have rendered very active service to the Society in many ways, and have been on the Council before—Mr. Thomas Jewell Bennett, and Mr. Arthur Crozier Claudet. Mr. Bennett has long been a member of the Committee of the Indian Section, Mr. Claudet is a Past-President of the Institution of Mining and Metallurgy, and has been a member of the Society since 1888. To replace Mr. Carmichael Thomas as Treasurer, the Council propose Professor J. M. Thomson, who retires by seniority from the Council.

The balloting list also bears the name of Sir George Birdwood, who is nominated by the Council for re-election to the Soane Trusteeship, as mentioned in another portion of this report.

XXVII.—Obituary.

Compared with some recent years the losses by death among the members, which the Council have to deplore, are less numerous than usual. Sir Benjamin Baker, who died last month, had served on the Council at intervals since 1888, and took an active interest in the work of the Society. His personal loss was felt very greatly by many Members of the Council, who knew him well and esteemed him highly. General Michael,

who took a very active interest in the Indian Section, and in 1894 read a paper on Forestry, was elected a Member of the Council in 1890, and served on it for one year. Another former Member of Council who died during the past year was Mr. James Dredge, who served on its body from 1890 to 1893.

Mr. Herbert Mills Birdwood was a very valuable member of the Committee of the Indian Section. He read two papers before the Section, for one of which he received the Society's medal. Not long before his death he read, in the absence of its author, Captain Barnes's paper on "The Bhils of Western India." Another useful member of the Indian Section Committee was Mr. Lionel Ashburner. He was elected a member of the Society in 1892. Yet another well-known figure at the meetings of the Indian Section, and a constant attendant at the Committee meetings, was Mr. Martin Wood, who had been a member of the Society since 1881, and of the Indian Section Committee since 1890.

Mr. Allan Wyon, whose firm for many years produced the Society's medals, became a member of the Society in 1892, and seven years later he read an interesting paper on the Great Seals of England. Mr. Sebastian Davis, who joined the Society in 1882, was a very frequent attendant at the Society's meetings. He was one of the oldest members of the Royal Photographic Society, which he joined in 1857. Lord Leven, who died last August, became a member of the Society in 1903. Mr. C. D. Abel had been a member of the Society since 1886. In 1904 he read a paper on "The Patent Laws," for which he was awarded the Society's medal.

Three very distinguished Foreign Corresponding Members of the Society died during the past year—Sir Dietrich Brandis, who took part in many of the recent discussions on matters connected with Forestry, and the two illustrious chemists, one French and the other Russian, Professor Marcellin Berthelot, and Professor Mendeleef.

XXVIII.—Finance.

The annual statement of receipts and expenditure was published—in accordance with the usual practice—in the *Journal* last week. It shows the revenue and expenditure for the financial year ending May 31st last, the Assets and Liabilities of the Society, its Investments and the Trusts standing in its name.

The Chairman, in moving the adoption of the Report, said they were fully justified in saying that it was a very good one. The papers read during the past session had given great satisfaction, and several of them were eminently good. The papers and lectures had ranged over a very large field, and there was scarcely a subject of human interest which was not at some time or other brought before the Society. He noticed the applause with which the announcement of the award of the Albert Medal to Lord Cromer had been received, and thought all the members would agree that it could not have been bestowed more worthily. As was shown in the paragraph in the Report, the award was not at all outside the scope of the Society, and the Council were acting quite in accordance with its constitution in recognising the valuable work which Lord Cromer had done in Egypt. He also referred to the admirable character of the Juvenile Lectures this session, which he felt sure had proved exceedingly interesting to adults as well as to juveniles. He thought the Society was to be congratulated on the fact that Sir William Ramsay had promised to give the first Aldred Lecture next session. He also spoke of the loss which the Society had sustained by the death of Sir Benjamin Baker, who took a great interest in the work of the Society, and was an assiduous member of its Council. Another matter with which the Council were dealing, although it was not in the Report, was the question of additional accommodation, which was very badly needed for the development of the Society. They had hoped at the beginning of the year that it would have been possible to secure further space on their present site, but up to the present the negotiations had not borne fruit, and they were now, at the end of the year, no better off than they were at the beginning. The financial position of the Society, as would be seen from the balance-sheet, was most satisfactory.

Mr. William Whitaker, F.R.S., seconded the adoption of the Report. He congratulated the Society on the admirable manner in which the year's work of the Society was epitomised, and thought it was a great advantage to the Members to have before them a recapitulation of the papers read during the session. He could assure the Members that the Society was not the only one that needed fresh quarters, for the necessity of obtaining additional accommodation seemed to be chronic amongst all the societies with which he was connected. He thought the Society had been very well served during the past year, and that the papers and lectures had been of the highest class.

The adoption of the report was then agreed to.

The Chairman, in complimentary terms, moved a cordial vote of thanks to Sir Henry Trueman Wood (the Secretary), Mr. Henry B. Wheatley (the Assistant Secretary), Mr. S. Digby (the Secretary of the

Indian and Colonial Sections), and the other officers of the Society. He said that no one who attended the meetings and read the weekly *Journal* could fail to recognise how efficiently the work of the Society was done by its staff, and their thanks were especially due to Sir Henry Wood and his colleagues.

The SECRETARY returned thanks for this expression of confidence in himself and in the other officers of the Society.

The ballot having remained open for one hour, and the Scrutineers having reported, the CHAIRMAN declared that the following had been elected to fill the several offices. The names in *italics* are those of members who have not, during the past year, filled the office to which they have been elected.

PRESIDENT.

H.R.H. The Prince of Wales, K.G.

VICE-PRESIDENTS.

H.R.H. The Duke of Connaught and Strathearn, K.G.
Duke of Abercorn, K.G., C.B.
Sir William Abney, K.C.B., D.C.L., D.Sc., F.R.S.
The Lord Chief Justice, G.C.M.G.
Sir Steuart Colvin Bayley, K.C.S.I., C.I.E.
Sir James Blyth, Bart.
Sir William Crookes, D.Sc., F.R.S.
Lord Curzon of Kedleston, G.C.S.I., G.C.I.E.
Francis Elgar, LL.D., F.R.S.
Hon. Sir Charles W. Fremantle, K.C.B.
Robert Kaye Gray.
Sir Cnarles Augustus Hartley, K.C.M.G.
Colonel H. C. L. Holden, R.A., F.R.S.
Lord Kelvin, O.M., G.C.V.O., D.C.L., LL.D., F.R.S.
Sir William Lewis, Bart.
Sir Philip Magnus, M.P.
Sir Westby B. Perceval, K.C.M.G.
Sir William Henry Preece, K.C.B., F.R.S.
Sir Owen Roberts, M.A., D.C.L., F.S.A.
Alexander Siemens.
Carmichael Thomas.
Sir Aston Webb, R.A.
Sir John Wolfe-Barry, K.C.B., F.R.S.

ORDINARY MEMBERS OF COUNCIL.

Thomas Jewell Bennett, C I.E.
Sir William Bousfield, M.A., LL.D.
Michael Carteighe, F.O.S.
Arthur Crozier Claudet.
William Charles Knight Clowes, M.A.
Henry Hardinge Cunynghame, C.B.
Henry Graham Harris.
Sir John Cameron Lamb, C.B., C.M.G.
Hon. Richard Clere Parsons, M.A.
Sir Walter S. Prideaux.
Sir Boverton Redwood, D.Sc., F.R.S.E., F.C.S.
Sir William Hood Treacher, K.C.M.G.

TREASURERS.

Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.
Prof. John Millar Thomson, LL.D., F.R.S.

SECRETARY.

Sir Henry Trueman Wood, M.A.

SOANE TRUSTEE.

Sir George Birdwood, K.C.I.E., C.S.I., M.D., LL.D.

On the motion of the CHAIRMAN, a vote of thanks to the Scrutineers was carried unanimously.

The Hon. Sir CHARLES FREMANTLE, K.C.B., proposed a cordial vote of thanks to the Chairman for his services in presiding at the meeting, and also as Chairman of Council during the past year. He was glad to say they would have the benefit of the services of Sir Steuart Colvin Bayley as Chairman of Council for another year, which he considered would be a great advantage to the Society.

The motion was seconded by Sir BOVERTON REDWOOD, D.Sc., F.R.S.E., who said that their high anticipations of the manner in which the duties of the Chairmanship of the Council would be discharged by Sir Steuart had been fully realised. The motion having been carried unanimously,

The CHAIRMAN acknowledged the vote of thanks.

The meeting then adjourned.

THE MEXICAN ISTHMUS RAILWAY.

On January 1st last the Tehuantepec Railroad, which runs across Mexico, a distance of 189 miles, was opened, and the experience already gained in working affords data for opinion upon the probable commercial results of this great undertaking. The Isthmus of Tehuantepec lies between the parallels of latitude 16° and 18° North, and the meridian of longitude 94° and 96° West. The Coatzacoalcos River, which rises at the foothills of the Sierra Madre, empties into the Gulf of Mexico, and at its mouth a natural harbour is formed, which is obstructed by a bar. On the Pacific coast, at Salina Cruz, there is no natural shelter—nothing but an open ocean roadstead. The Tehuantepec Railway joins these two points. As the bird flies, it is about 125 miles across the isthmus from ocean to ocean, but by the route which the railway is compelled to follow the distance is 190 miles. With the exception of the Panama route, it is the shortest trans-continental route. From the earliest

times its advantages as a line of communication between the two oceans have appealed to travellers and explorers. Hernan Cortes predicted that it would become the highway of the world's trans-continental commerce, and Humboldt described the isthmus as "the bridge of the world's commerce." The first actual steps for constructing some line of communication across the isthmus dates back nearly half a century. Concessions were granted, and in due course forfeited owing to the inability of the concessionaires to fulfil their obligations. In 1882 the Mexican Government determined to build the railway themselves, but the contract entered into for the work was rescinded when about 67 miles of the road had been completed. In 1888 a loan of £2,700,000 was raised for the purpose of carrying out the work which was given to Colonel McMurdo, who undertook to finish the road in thirty months, but died in 1890. In the beginning of 1892 new contractors undertook to complete the line in fifteen months, but the contract was soon afterwards cancelled. In 1893 fresh contractors undertook to complete by September, 1894, and the railroad was actually completed in that year, but no sooner was that done than defects in construction, as well as want of suitable harbour facilities on both the Gulf and Pacific coasts, made it necessary to begin work over again. The Mexican Government then entered into negotiations with the firm of which Sir Weetman Pearson is the head. The result was an agreement under which Messrs. S. Pearson and Son not only undertook to construct the railway but also the ports at Salina Cruz and Coatzacoalcos. The work both on the railway and at the ports was carried out with characteristic thoroughness, and, as has been said, the railway was opened on January 1 last.

The difficulties in the way of construction, both on land and at sea, were great. The heavy rainfall during the rainy season, the exuberant vegetation and other tropical conditions, the scarcity of labour caused principally by the fears of yellow fever, were serious obstacles, but they were overcome, and the railroad is now in excellent structural condition, with a good road built of rock ballast, and new steel bridges, that across the Jaltepec river being of six spans, 560 feet in length, whilst the Chivela pass is entered and crossed at a height of 735 feet above sea level. The equipment of the road is of the most modern description. The gauge is of the standard one of 4 feet 8½ inches; the numerous bridges are of steel with solid masonry abutments; culverts of adequate capacity have been put in wherever required in solid masonry; nearly the entire road is now laid with 80 lb. rails, and is ballasted with crushed rock and gravel; the ties are of creosoted pine, native hardwood, and Californian redwood, and are provided with heavy steel tie-plates. The route will at first be worked with a single track, and it is calculated that ten freight trains, carrying 300 tons net, can be despatched in each direction every 24 hours. It is claimed that freight can be transferred across the isthmus within thirty hours after the vessel enters the harbour at the other terminus, and the company promise a freight train service of 12 hours from ocean to ocean. If, however, the movement of freight proves as great as is expected, the line will soon have to be double tracked. All the locomotives burn oil fuel, at present imported from Texas in tank-steamers, and unloaded into three large storage tanks at Coatzacoalcos, each with a capacity of 6,000 tons. Soon, however, Messrs. Pearson and Sons' oil fields at San Christobel, on the Coochapa, will be in a position to supply oil. The consumption of oil fuel in the locomotives has a great advantage for travellers by the line in the freedom from smoke and coal dust, whilst an ingenious device for sprinkling the road bed with crude oil, heated to 210° Fahr., for destroying the roots of plants, and so preventing vegetation from overgrowing the track, lays the dust, and adds to the comfort of travelling in a hot climate.

The two terminal ports are still far from being completed, though the works at both ends are sufficiently advanced to admit of the entrance of large ships, and to make possible the speedy handling of freight. At Coatzacoalcos little remains to be done beyond deeper dredging of the channel on the bar, and the building of further wharves and warehouses, but at Salina Cruz there is still much to be done in dredging out more space in the inner harbour, building wharves and warehouses, and finishing the dry docks. The work on the harbours is not expected to be completed until 1909. The harbour at Coatzacoalcos, as well as that at Salina Cruz will have a depth of 33 feet at low water. At Salina Cruz on the Pacific, the engineering problem was much more serious than in the Gulf. The "Northers," which sweep across the isthmus beat the surf out to sea, and, since there is no natural shelter, it was necessary to construct both an outer or refuge harbour, and an inner harbour with wharves or a dry dock. Enormous breakwaters have been built far out into the sea, ending in a depth of 70 feet, with the convex side turned seaward, form the outer harbour. The entrance to this harbour is 656 feet across. The east breakwater is five-eighths of a mile long. It extends out for 1,200 feet in a straight line from the shore, then bends for 825 feet in a curve with a radius of about 1,900 feet, and then continues in a straight line for about 1,235 feet. The West breakwater is about 1,900 feet long.

The geographical effects of the railway upon commerce must be great. Some of the saving in distance by the new route is shown by the following Table of distances given in nautical miles:—

	Viâ Tehuantepec. miles.	*Viâ* Panama. miles.
From New York to San Francisco	4,226	5,401
From New York to Yokohama	8,666	9,831

From New Orleans to San Francisco	3,091	..	4,700
From Liverpool to San Francisco	7,182	..	8,033
From Liverpool to Honolulu	8,511	..	9,263
,, ,, Acapulco	5,274	..	6,033
,, ,, Yokohama	11,478	..	12,500

The line will compete under advantageous conditions for traffic between European and American ports on the Atlantic on the one hand, and ports in the far East and Australasia and on the Pacific coast of the American continent on the other. This traffic is now moving by vessels round Cape Horn, or through the Straits of Magellan, or by the Suez Canal, or by land over the trans-continental lines of North America. The prospects of freight are already so large that the officials informed Mr. W. Max Müller, Secretary to His Majesty's Legation at Mexico (from whose report, Cd. 3284, the particulars of the railway given above have been taken), that they were afraid to properly advertise their route for fear of not being able to comply with the demands of the traffic. The average saving in distance by the Tehuantepec route over Panama to all places on the Atlantic coast of the United States and Europe is, estimated at 1,250 miles. The ordinary freight steamer makes about ten miles an hour, say 250 miles a day, requiring five days longer *viâ* Panama, assuming the time of crossing the two isthmuses to be the same. It will take a steamer about one day to pass through the Panama Canal and the freight about two days to pass over Tehuantepec from ship to ship, leaving four days to the advantage of Tehuantepec. The extra cost of four days to a steamer, say 2,000 dols., plus the canal tolls, would make a 5,000 ton cargo about 10,000 dols. *viâ* Panama. The cost *viâ* Tehuantepec would be less, and there would be the saving in time of four days, which is of moment in this age of rapid transportation. The geographical advantages of the Tehuantepec route are very considerable.

UNITED STATES PETROLEUM PRODUCTION.

The oil production of the United States comes from five great fields and a few scattered States. The division into fields is governed by the quality of oil produced and the geographical position. Most of the great fields include more than one State, and in one case a State enters into two fields; this is Ohio, which, in its eastern and southern portion, belongs to the Appalachian field, and in its western part to the Lima, Indiana, and Illinois field. The five great fields referred to are the following:—The Appalachian field, the Lima, Indiana and Illinois field, the Mid-Continent field, the Gulf field, and the California field. As regards the scattered States, small quantities of oil have been produced for a number of years from Wyoming, Colorado, and Michigan. There are indications of oil, but no actual production from a number of other States. Wyoming shows the greatest probability of developing an oil field of importance.

The Appalachian field is the pioneer oil producer of the United States. From its point of discovery on Oil Creek, in Western Pennsylvania, it has been extended in a general north-eastern and south-western direction, until it now takes in an area of fully 50,000 square miles, and includes the production from New York, Pennsylvania, Eastern and Southern Ohio, West Virginia, Tennessee, and Kentucky.

The Lima, Indiana and Illinois field commenced to produce oil in commercial quantities in 1885, near Findlay, in north-western Ohio. This territory has been expanded until it extends diagonally across the north-west corner of Ohio and into Indiana. During the year 1905 a production of considerable extent was developed in eastern Illinois, near the Indiana line. These different productions are all grouped into the Lima, Indiana and Illinois field, which includes the production from Western Ohio, Indiana, and Illinois.

The Mid-Continent field first successfully produced natural gas in commercial quantities in 1894, in Kansas, and although a small quantity of oil was found at or near that date, it was not until the year 1899, that this oilfield was thoroughly opened up. Since that time, prospecting has gone on rapidly, extending the development in a south-westerly direction into Oklahoma and Indian territory. The Mid-Continent field includes the oil territory in Missouri, Kansas, Oklahoma, and Indian Territory.

The Gulf-field includes in its production the oil from Texas and Louisiana. The prominence of this field commenced with the Lucas gusher at Spindle Top in 1901. Prior to this time there was, from Corsicana and other districts of Texas, a production of oil of entirely different qualities from that produced below the coastal plains of Texas and Louisiana. This difference in quality, would justify the separation of the Corsicana district into a distinct field, but as the oil from this district is only about one per cent. of the production of the Gulf-field, this separation is not made in the United States statistics of oil production.

The California field.—Petroleum has been known and used in a small way in California since 1856. In 1865, an oil excitement passed over the State, during which many wells were drilled, and some petroleum was found. The real opening up of California as a great petroleum field dates, however, from 1892, when a shallow well, near an asphaltum deposit, in the city of Los Angelos was drilled, and a small but steady production of petroleum was obtained.

According to a report of the United States Department of the Interior, the most important features in connection with the production of petroleum in the United States, for the year 1905, are as follows:—(1.) The production was greater by 17,636,620 barrels than in any previous year. (2.) The value of the production for the year 1905 was £3,546,000 less than for the year 1904. (3.) The production of petroleum in the United States has

more than doubled within the last six years, the increase being in the heavier grades of the fuel class, while the production of the lighter or illuminating oils has remained constant. (4.) During the year the development of the Mid-Continent field and the extension into Illinois of the Lima-Indiana field indicate a great increase in the future production of the lighter grades of oil. (5.) The production of the great Eastern fields shows indications of permanent decrease. (6.) The completion of the pipe line from Humboldt, Kansas to Whiting, Indiana, marks another step in the transportation of oil. During the year 1905 there were produced within the United States 134,717,580 barrels of petroleum. This is an increase over the production of the year 1900 of 71,097,051 barrels, or considerably more than any total yearly production up to 1902. The foregoing statement gives an idea of the magnitude of the increase in the oil business of the United States. It does not, however, give a true and clear understanding of the business at this time. A simple statement of the number of barrels of petroleum taken from the earth each year no longer shows the condition of the industry. The kind and quality of the oil produced must now be taken into consideration, to have a proper understanding of the relation of production to demand and consumption. Of the production of the year 1905, 70,474,078 barrels were from the Gulf and California fields. This is almost exactly the quantity by which the production of the year 1905 exceeds that of the year 1900. The petroleum of the Gulf and California fields is of the heavier variety, and has a residue of asphaltum. Oil of this quality, although capable of producing a small percentage of illuminating oil, has its principal value in its use as a fuel. It is the demand for this purpose which must be looked to for the consumption of the production of heavy oils. The advantages in the use of petroleum as a fuel are many, and its acceptance as such is sure to grow until the price arrives at a figure that will bring it into competition with other fuels. It is well established that a barrel of petroleum is equivalent in heat-producing effect to between one-fourth and one-third of a ton of coal; hence the value of fuel petroleum must finally adjust itself to the cost of one-fourth to one-third of a ton of coal at the point of consumption. Prior to the year 1904, the greater part of the lighter grades of petroleum that are especially adaptable to the manufacture of the illuminating oils, came from the Appalachian and the Lima-Indiana fields. For a number of years the combined production of the two fields has been remarkably constant. During the period comprised between the years 1894-1903 inclusive, it has averaged about 55,500,000 barrels a year. The consumption of illuminating oil from 1894 to 1903 slightly exceeded the production. The stock held by the large pipe-line companies, which were 33,772,923 barrels at the end of the year 1897, were reduced to 20,772,823 barrels at the end of the year 1903. During the year 1904 there was a consumption of 55,968,171 barrels, against a production of 63,855,710 barrels, and in 1905 a consumption of 60,875,677 barrels, against a production of 63,855,710 barrels. These two years caused an increase in the stocks held of 8,717,140 barrels. The value of the total production of petroleum in the United States in 1905 was £17,532,000, as compared with £21,078,000 in 1904, although the production of 1905 exceeded that of 1904 by 17,636,620 barrels. As regards the order of production of the petroleum-yielding States, California still maintains a position at the head. Its output during the year was over one-fourth of the total production of the whole country. Texas comes next, showing a production of one-fifth of the total production; and then follow Kansas, Indian Territory, and Oklahoma.

PATENTS, DESIGNS, AND TRADE MARKS.

A Parliamentary paper (164) has been issued containing the 24th report of the Comptroller-General of Patents, Designs, and Trade Marks, with appendixes, for the year 1906. The report states that the work of carrying on the official investigation required by section 1 of the Patents Act, 1902, has proceeded satisfactorily during the year. This investigation, so far from having a deterrent effect on inventors, as was anticipated by some who were opposed to it, has been accompanied by an immediate and substantial increase in the number of complete specifications filed at the Patent Office. The number of these specifications, which was 15,831 in 1903 and 15,925 in 1904, rose suddenly after the investigation began, on January 1, 1905, to 18,806 in that year and 18,228 in 1906. A considerable part of the increase in 1905 was attributable to the more expeditious filing of these specifications, necessitated by the shortening of the time allowed for this purpose from nine to six months. But no such explanation will account for the increase in 1906. It is difficult to account for it on any other assumption than that inventors generally have appreciated the benefits which the official search has conferred on them. The applications for patents received in 1906 numbered 30,002, as compared with 27,577 in 1905, an increase of 2,425, or 8 8 per cent. Of these applications 21,012 were accompanied by a provisional specification, and 8,990 by a complete specification. The total number of patents which expired during the year was 14,146, and the total number of new patents sealed was 14,707. Thus the number of existing patents was increased during the year by 561. The number of designs applied for during the year amounted to 21,262 exclusive of 739 "sets" of designs. In the previous year 23,262 single designs and 869 "sets" were applied for. The number of designs registered was 21,212. The number of applications made in 1906 for the registration of trade marks (including 153 applications made to the Cutlers' Company of Sheffield) was 11,414, as compared with 10,527 in 1905. The number of trade marks registered was 4,731.—*The Times.*

HOME INDUSTRIES.

The Railway Companies and Coal Carriage. —The railway companies have intimated that on and from the 1st of July next coal, coke, breeze, and patent fuel will be charged "on the Standard Imperial avoirdupois weight of 20 cwts. per ton net." For a decade past the railway companies have been practically carrying 20½ cwts. of coal for the rate authorised to be charged for 20 cwts., and it is hardly surprising that at a time when their coal bills show, or must shortly show, serious increase owing to enhanced prices, they seek to partially to recoup themselves as indicated. Naturally the coal companies object, and it remains to be seen what the Board of Trade and the Railway Commissioners will decide. The contemplated charge is equivalent to an increase of 2·44 per cent. in the rates, and on the coal trade of London will represent an addition of between 2d. and 3d. per ton, taking the average. On the face of it the railway companies would seem to be within their rights. The special allowance as to weight was given under the stress of competition, and where there is no binding undertaking to continue it may, one would suppose, be withdrawn at pleasure. But the theoretical right of railway companies to charge what rates they please provided they do not exceed the Parliamentary maximum rates would seem to conflict with the clause of the Railway and Canal Traffic Act of 1894, which throws upon the companies the onus of proving that any increase in rates as applied to a particular class of traffic is warranted by the circumstances of the case. The clause in question enacts that where a railway company has directly or indirectly increased any rate or charge then, "if complaint is made, it shall be for the company to prove that the increase of the rate is reasonable, and for that purpose it shall not be sufficient to show that the rate or charge is within any limit fixed by an Act of Parliament or by any Provisional Order confirmed by Act of Parliament."

A Shipbuilding Combine.—The interesting announcement is made that Messrs. Harland and Wolff, Limited, of Belfast, and Messrs. John Brown and Co., Limited, of Clydebank and Sheffield, have entered into a sort of semi-amalgamation. The capital of John Brown, Limited, now consists of £1,750,000 of 5 per cent. cumulative preference shares of £10 each, 1,160,000 ordinary shares with 15s. paid up, and 590,000 shares fully paid. In their report the directors say that "with a view of strengthening the shipbuilding connection of the company, we have arranged for the acquisition of an interest in the firm of Harland and Wolff, Limited, of Belfast," and that for this purpose, as well as for completing the purchase of a field of ironstone, and for building two blast furnaces at Frodingham, additional capital will be created. Harland and Wolff, it is understood, will take up the greater part of the new shares, and John Brown and Co. take shares in new capital to be created by Harland and Wolff. These two companies are the two largest shipbuilding companies in the world, and it is interesting to remember that whilst Harland and Wolff are intimately connected with the great American shipping combination which five years ago secured the control of the White Star and other lines, Messrs. John Brown and Co. built the *Lusitania* for the Cunard which, with her sister ship, the *Mauritania*, is intended, by the help of a large Government subsidy, to combat the American combination. At present, Messrs. Harland and Wolff have their hands very full, and, unaided, might find difficulty in building to time the nine very large and fast steamers the American company have ordered for the Atlantic trade. The pressure will be relieved by passing on some of the contracts to Clydebank, the division of contracts ensuring continuity of work at both yards. At their Sheffield works Messrs. John Brown and Co. turn out the heaviest known plates rolled, and their association with Messrs. Thomas Firth and Sons, Limited, give them the supply of most other structural steel for shipbuilding. The semi-combination of these two great shipbuilding organisations is the latest illustration of the present day tendency towards industrial combinations, a tendency not without its serious disadvantages from the national point of view.

Tin, Lead, Spelter.—A little more than a year ago tin was quoted at £213 per ton, being by much the highest price upon record. Since then it has fallen steadily, until at present it is under £180. But it is noteworthy that the stock of tin in London has now been reduced to 1,405 tons, a record figure. Th imports of tin in May were much lower than usu being 2,695 tons against 3,651 tons in 1906, a 3,783 tons in 1905. Also the imports of tin ore a much below those of last year. On the other han the value of lead continues to rise, and has brought near that of spelter. It has not so nearly appreciat since October, 1900, when virgin spelter was quot at £18 15s. for a few days, and lead at £18 7s. 6 Lead then declined in price until it dropped t £10 10s. per ton in December, 1901. From tha date until recently there was a difference of fron £7 to £12 per ton between the two metals. Thi difference has now been reduced to about £2 17s. 6d. and it is possible that it may disappear entirely. Th market for spelter is declining, and the rise in lea appears to be due to shortness of supply alone Spanish producers are said to have sold their pro duction ahead to a considerable extent, and littl increase is to be looked for from Australia.

The Iron Trade.—It has been recently stated with some persistency that the industrial "boom" in Germany shows signs of nearing the end, and that these are specially noticeable with respect to the iron trade. As the German position has a very direct and

important bearing upon industries in this country, a statement just issued by the German Steel Syndicate, and intended to counteract the reports of reaction, will be read with attention. According to this official communication, the orders on the books for unfinished products for delivery during the four months June to September amount to nearly $2\frac{1}{2}$ million tons. The syndicate estimate that they will be required to keep back about 10 per cent. of this for later delivery, leaving $2\frac{1}{4}$ million tons to be delivered by the end of September, whereas they have provided for an output by the members during that period of only 2,060,000 tons, and it will probably be impossible to deliver more than 1,950,000 tons. Many more orders could have been booked, the syndicate say, if it had been possible to quote anything like near delivery. The decline in exports is reported to continue, but this is entirely due to the inability of the works to satisfy the home demand. It is admitted that the orders for girders are 100,000 tons less than at the corresponding period last year, but this is said to be due to the position in the money market, and was foreseen by the syndicate over a year ago. On the other hand, orders are on the books for over 300,000 tons more railway-building material than last year. The decrease in the output from the works is attributed to the scarcity of coal and raw material, the diminished production of the workers individually, and the shortage of railway waggons. The syndicate consider the outlook excellent, and that it will probably remain so.

Fast Colours.—At a meeting of the directors of the Manchester Chamber of Commerce, held a few days ago, they had under discussion the tests for colours as regards fastness in dyeing and printing. The test for fastness recommended by the Chamber is: "Let two parts by weight of the neutral soap known as Marseilles soap be dissolved in 1,000 parts by weight of soft water; put in the fabric for fifteen minutes without rubbing at a temperature not to exceed 150 degrees Fahrenheit. Any colour that will resist this should be considered fast; the converse being of course implied." Mr. George Edward Wright, of Offerton, Stockport, writes as a dyer of many years experience, to deny the efficacy of the test. It reads to him rather as if it might be intended to hide the faults of the new colours than to be a test of their stability. He wants to know what is Marseilles soap as made to-day. There are, he says, twenty different qualities of the soap on the market. Then the fabric is to be immersed for fifteen minutes at a temperature of 150 degrees Fahrenheit. There are a whole host of new direct dyes that will stand this test splendidly, and it is about the only one they will stand. They will hardly stand one day's sunshine, and, according to the test set down, they must never go to the wash, for the ordinary English washerwoman, or the natives wherever these goods go, will (if they desire to clean the garment) subject it to a much more severe test."

Directors' Fees in Cotton Mills.—The question of directors' fees is a favourite subject of discussion in Oldham, where probably more working-men are interested in joint stock companies than in any other town of its size in the United Kingdom, and very exceptional interest is shown in the affairs of its many cotton companies. The general impression at Oldham seems to be that although modest as compared with the fees usually allowed to London directors, the remuneration of Oldham directors is too large. The average seems to have risen a good deal of late years. A generation ago the fees were usually very small, about £4 a quarter, but many Oldham companies to-day allow £50 a year to each director. In some cases the fees would seem to be even higher. For example, a few days ago an Oldham company passed a resolution to pay £100 per annum to each director as against £75 hitherto, but strong opposition to this increase having been evinced by leading shareholders, the directors decided not to act upon the vote. Much must depend upon the extent to which the duties of the office trench upon time. With some shareholders the objection is not so much to a substantial fee being paid to each of the directors as to the practice of one director sitting upon many boards.

Mining Royalties.—There is little present likelihood of Parliamentary interference with Mining Royalties, but from time to time the public are reminded that in some cases trade is rather seriously handicapped by a system less favourable to the producer than that followed in countries which are our most serious commercial rivals. The Royal Commission on Mining Royalties which sat some time ago estimated Mining Royalties to average about $5\frac{1}{4}$d. per ton of coal, and about 9d. per ton of iron ore in 1889, but the price of coal is now at least one-third higher than in 1889, and as royalties are in many cases based on "sliding scale" principle they probably now reach 8d. per ton of coal on the Royal Commission's calculation. A correspondent of the *Manchester Guardian* gives reasons for the conclusion that royalties of all kinds — lease - fees, "dead" rents, underground and surface way leaves, water leaves, air leaves, &c.—now amount to much more than 8d. per ton, and puts it at an average of 1s., and the tendency is said to be still upward. In Germany mining royalties are fixed by the State at 2 per cent. on the profits of the business; in Belgium the rate is $2\frac{1}{2}$ per cent. on profits, and in France 5 per cent. on profits. The State owns the minerals and grants the mining concessions. No profit no royalty. Assume that a German company makes 6s. per ton profit, it pays only about 1s. 4d. in royalty. More than any other country the United Kingdom is dependent upon manufactures, and chief among them are now iron and steel. An excessive tax on minerals in the way of royalty must necessarily handicap those who have to bear it.

OBITUARY.

ALEXANDER STEWART HERSCHEL, M.A., D.C.L., F.R.S.— Dr. Herschel, Hon. Professor of Physics and Experimental Philosophy at Durham College of Science, Newcastle-on-Tyne, died on the 18th inst. at his residence, the Observatory-house, Slough, where previously resided his distinguished grandfather (Sir William Herschel) and father (Sir John Herschel). He was the second son of Sir John Herschel, and was born at the Cape of Good Hope in 1836, when his father was engaged on his historical series of observations at the Cape. He wrote a large number of papers on Meteoric Astronomy and Meteorological subjects, which are registered in the Royal Society Catalogue of Scientific Papers. He was elected a Fellow of the Royal Society in 1884, a Fellow of the Royal Astronomical Society in 1867, and a Member of the Society of Arts in 1892.

SIR JOHN FREDERICK CREASE, K.C.B.—Major-General Sir John Crease, late Commandant Royal Marine Artillery, died at Guildford on the 21st inst. He was born in 1836, educated at Upper Canada College, Toronto, and entered the army in 1854. As a subaltern he served in the China war of 1857-61. In the Ashanti war of 1873 he was present at the action of Essaman, and his services there were mentioned in despatches, and were rewarded with the brevet of Major. He was the inventor of an anti-fouling composition for coating the bottoms of iron ships, largely used in the Royal Navy; of a system for the drainage of Portsmouth; and of a composition for raising smoke to cover an attack when smokeless powder is employed. Sir John Crease was elected a member of the Society of Arts in 1878, and in April, 1902, he read a paper on "Ceuta and Gibraltar," for which he received the Society's silver medal.

GENERAL NOTES.

ICELAND FISHERY.—Signs are not wanting, says Mr. Consul Walsh in his report on the trade of Dunkirk (Cd. 3283), to show that the Iceland cod line fishing is a declining industry in a great measure owing to the successful competition of steam trawlers. The number of sailing vessels leaving for these fisheries decreases yearly. The results of the catch by the 54 vessels that went out last year amounted to 2,321 tons of cod compared with 2,826 tons in 1905, and 119 tons of oil compared with 205 tons in 1905. For the current season a change has been made in the mode of payment of the crews, among whom 1s. per barrel of about 3 cwts. is divided, plus 2d. per tail of the codfish caught by each man. There has also been a reduction made in the advances given to the crews which in preceding years varied from 650 francs to 750 francs. This has now been reduced to 550 francs. It is hoped that this arrangement will act as an incentive to the crews, who under the previous system received before setting out practically all they could hope to gain during the

RUBBER IN FRENCH WEST AFRICA.—The French Government is turning its attention to the better administration of the rubber forests of French West Africa. On the whole the quality of the rubber produced continues to improve, and prices have risen all round. The rubber, however, from the Ivory Coast and the Casamance district is still inferior to that from the other colonies, and somewhat strict measures are to be taken to improve it. The shortage in the export of rubber is due to adulteration which has made Ivory Coast rubber to a certain extent unacceptable in Europe, and secondly, less rubber has been brought across the Gold Coast frontier from Ashanti to exchange for gunpowder at Aborisso. A special survey is being made of the chief rubber-producing districts, which will eventually be divided into three categories as follows:—(1) Unexploited districts. These consist only of a few regions in the Ivory Coast forests. (2) Districts which are exploited but have not been spoiled by excessive production and unscientific methods of collection. (3) Districts which have been spoiled for the above reasons. These latter are in the majority. When the survey and classification are complete the Governor General will, by decree, close the worst districts to rubber collection, so as to give the plants time to recuperate. A beginning will probably be made in 1908.

GERMAN TOYS.—In his report on the trade of the consular district of Leipzig just issued (Cd. 3283), Consul-General Baron Bernhard von Tauchnitz refers to the export value of toys, which for 1905 was 20,260,000 marks, thus taking the tenth place among the important German articles of export to the United Kingdom. Of all British colonies Australia remains the best buyer of German toys, taking goods to the value of 1,390,000 marks in 1905. Toys take the third place among the chief imports of New Zealand. The import into British India has again increased. The value for 1902 was 574,000 marks, for 1903 700,000 marks, for 1904 832,000 marks, and for 1905 852,000 marks, 1906 is expected to show a further increase. On the other hand the exports to South Africa fell from 677,000 marks in 1903, to 369,000 in 1905. A further decline is also discovered in the export to Canada, the value for 1904 and 1905 being 913,000 and 551,000 marks respectively. total value of the exports of German toys to the United Kingdom and her colonies for the year amounted to 24,000,000 marks, which represents about 35 per cent. of the total exports to all countries, which amounted to about 68,000,000 marks.

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FRIDAY, JULY 5, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CHAIRMANSHIP OF COUNCIL.

On Monday, 1st inst., at their first meeting the Council elected Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., as Chairman for the ensuing year.

COUNCIL.

At the meeting of the Council on Monday, 1st inst., Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., was elected a Member of Council in place of Sir Walter S. Prideaux, who is unable to accept the office to which he was elected at the Annual General Meeting on the 26th ult.

CONVERSAZIONE.

The Society's Conversazione will be held, by arrangement with the Council of the Royal Botanic Society, in the gardens of that Society, Inner Circle, Regent's - park, on Tuesday evening, July 9th, from 9 to 12 p.m.

The central portion of the gardens only will be used. The Conservatory and the Club house will be open.

The reception, by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman, and the other members of the Council, will be held at the entrance to the Conservatory, near the Broadwalk, from 9 to 10 p.m.

The Victoria-house, containing the Giant Water Lily (Victoria Regia), and other interesting tropical plants, will be open to visitors, and will be specially illuminated for the occasion.

An Exhibition of Growing and Cut Roses and other Flowers will be arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham-cross.

A Selection of Music will be performed by the String Band of the Royal Marine Light Infantry (Portsmouth Division) in the Conservatory, and by the Band of H.M. Coldstream Guards in the Gardens, commencing at 9 o'clock.

A "Watteau" Pastoral Play in three acts, entitled "La Marquise," will be performed in the Gardens by Mr. Patrick Kirwan's Idyllic Players, commencing at 9.30 p.m.

A Concert and Entertainment, under the direction of Mr. Patrick Kirwan, will be given in the Club-house at 9.45 and 10.45 p.m.

Each member is entitled to a card for himself (which will not be transferable) and a card for a lady. These tickets have now been issued. In addition to this, a limited number of tickets will be sold to members of the Society, or to persons introduced by a member, at the price of 5s. each, if purchased before the day of the conversazione. On that date the price will be raised to 7s. 6d.

Members can purchase these additional tickets by personal application, or by letter addressed to the Secretary at the offices of the Society, John-street, Adelphi, W.C. In all cases of application by letter a remittance must be enclosed. Each ticket will admit one person, either lady or gentleman, and must be signed by the member applying for it.

Tickets will only be supplied to non-members of the Society on presentation of a letter of introduction from a member.

Further particulars as to the musical and other arrangements will be given in the Programmes, which will be distributed on the evening.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to

life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

LIQUOR TRAFFIC LEGISLATION OF THE UNITED STATES.

At a time when the Government is believed to be contemplating liquor traffic legislation, the report of Mr. R. C. Lindsay, Second Secretary to His Majesty's Embassy at Washington (Cd. 3284). upon the liquor traffic legislation of the United States, is a timely reminder of what has been done in America to restrict the excessive consumption of alcohol. Probably there is no question which has attracted greater attention in the United States, induces sharper controversy, or has led to more legislation. During the past three years the States have enacted 164 separate laws directly affecting the liquor traffic. Mr. Lindsay has found it difficult to supply information as to the practical working of these laws. This usually depends on the local authorities, and the effects of the same law may be different in adjoining counties. Such statistics as can be obtained furnish little basis for comparison without a thorough knowledge of local conditions. Especially so is it with figures which are often given of the numbers of arrests for drunkenness. The variations noticed may be due not so much to changes in the law as to changes in the personnel of the police, or in the policy of the saloons, with regard to intoxicated persons, or to the rise of some energetic civic reform association. At one time or another 17 States have had stringent prohibition. It is now only retained by three, and in those, says Mr. Lindsay, it cannot be looked upon as a success. Parts of prohibitory States have always been in open violation against the law. Drinking has never been impossible, the sale of liquor has always been profitable, and seldom disreputable in the eyes of the public. Violation of the law has been open and avowed. In Urban districts at any rate, it has not been found possible to find any sound ethical basis for the law, or to persuade the majority to regard its violation as immoral. Without the backing of public opinion no enforcement of prohibition has been obtained, except at the price of raising animosities between rival factions of such intensity as seriously to disturb the community. Juries have violated their oaths; judges have hesitated to impose statutory penalties; blackmail and corruption have been directly instituted, and the law in general brought into contempt. Persistent disregard of the liquor laws is supposed to encourage disobedience to other enactments, and an example is cited in Kansas, where the fact that an anti-gambling law is almost a dead letter, has been attributed to the lax enforcement of prohibition in the cities of the State.

Local option is now the most widely prevalent system in the United States, embodying as it does the thoroughly American principle of decentralisation and delegation of authority. The Constitution allows each State, if it chooses, to prohibit the sale of intoxicants; so the States allow each county, city, or town likewise to adopt prohibition if they wish. It is almost invariably found that the towns vote for license, and the country districts for prohibition. The three States which retain prohibition are almost entirely agricultural communities. It is impossible to say whether prohibition has actually diminished drinking, but it has certainly made it more difficult for the ordinary man to get a drink, and temptation has thus been removed from many. Ohio is the purest example of the tax system. Iowa, though theoretically a prohibition State, really follows the same policy, the payment of a tax, and compliance with a number of well-devised regulations, being made a bar to proceedings against a dealer for selling liquor. It is noteworthy that the question of compensation, so important in this country, scarcely exists in the United States. The temperance feeling is so strong there that the license to sell liquor is looked upon as a franchise belonging to the Government, and a privilege only granted as a favour to certain selected individuals. The license is never issued for a longer period than one year, and from this fact the logical conclusion is drawn that it may be withheld when it lapses without the Government incurring any liability to compensate its holder. At one blow, and with no more than a few weeks' warning of any kind, South Carolina revoked all licences and turned the liquor business into a Government monopoly, but no compensation was given. Neither in any of the States where laws have been passed with the avowed object of reducing the number of saloons, nor in those in which licenses are at any time liable to be terminated by local option, is any provision made to compensate the dealer.

Maine may be called the home of prohibition. In 1905 the so-called Sturges Commission set to work and in Portland everything in the way of saloons and bar-rooms was closed, the Sheriff even seizing the liquors in the City Agency, which had just been opened, and had to be shut up for a considerable period. The result has been to draw the liquor trade into the hands of "Pocket Peddlers," and the sailors, longshoremen, strangers, and so on can get nothing but

the most villainous sort of liquor. "Prohibition," writes Mr. Keating, "while it certainly restricts the sale of liquor, does not suppress it. While the poor, improvident, or stranger is compelled to seek the 'Pocket Peddler,' the average non-abstainer can get rather more than he wants at the numerous clubs, or else at his or his friends' homes; and if his wants are running low, a telephone order to a dealer in a neighbouring State will soon replenish his stock by the next train, or by express." Where the sentiment of the community is adverse to the prohibition, the traffic is carried on in defiance of the law. The liquor would be kept in one house and conducted through pipes to another, the spigots being cunningly concealed; or a secret door would open and disclose a well-filled glass, or a revolving closet would be contrived in a partition wall, the thirsty one would place in it a token and a coin, and when the closet had completed its revolution, he would find in their place the means of quenching his thirst. All this secret trade brought with it the usual means of combating it. Professional informers and searchers abounded, and were generally of the lowest class. Blackmail flourished, the security of private life was violated, the costs of prosecution increased, and their results diminished, witnesses perjured themselves, juries would refuse to convict in cases of overwhelming evidence of guilt, and respect for the law vanished. Such is the story of temperance legislation in Iowa. On the other hand, it is admitted that it wiped out completely 150 breweries, compelled one of the largest distilleries in the country to cease business, and diminished public drinking. Whether or not it increased private drinking to a considerable extent is a matter of doubt, as also the question whether the quality of the liquor generally drunk did not deteriorate. On the whole, says Mr. Lindsay, there is much legislative unrest in regard to the liquor traffic, and every State is constantly amending its laws on the subject, but there is a well-marked tendency throughout the country to do everything possible with the object of restricting the traffic as efficiently as possible by the least obnoxious means, and of diminishing the evils which it brings in its train.

SMALL HOLDINGS IN THE UNITED KINGDOM.*

The several inquiries into the small holdings question, while they have brought together a great deal of valuable information, have still left the data very incomplete whereon to determine the economic position of the small holding. At the present time there is difficulty even in ascertaining the number and size of small holdings in the United Kingdom, while information is still more imperfect as regards the cropping and stocking of these holdings, their expenditure and receipts, and the general economic strength and efficiency of the small holding in relation to the medium and the large-sized holdings. Viewed from the point of view of the national balance of population, and from the standpoint of general social economics, the case for small holdings has received a wide provisional acceptance. But there is not yet ripe conviction on the matter, and this cannot come until there has been a thorough examination and settlement of the agricultural economics of the question.

Before proceeding, it may be well for the purposes of discussion to recall the definition of a small holding and to exclude certain classes of small holdings from the present consideration. The Small Holdings Act of 1892 defines a small holding as "land which does exceed one acre, and either does not exceed 50 acres, or if exceeding 50 acres is of an annual value for the purpose of income tax not exceeding £50." The present Small Holdings and Allotments Bill for England defines a small holding as from 5 to 50 acres, and places allotments at from 1 to 5 acres—a desirable limitation in the definition of a small holding. But it is desirable, in view of the very wide range of the type of small holdings, to define the scope of the present discussion still more particularly. Accordingly, I do not consider here holdings, whether under or over five acres, existing under conditions of soil and situation whereby a very specialised culture, such as bulbs, flowers, fruit, and vegetables, is carried out on a highly intensive scale. These are types to which everyone interested in the development of small holdings must attach great importance. But the problem which I raise for discussion is the small farm holding with average land and average facilities as regards markets, on which the holder is earning his whole livelihood. What is the economic position and outlook of this type of holding? The question of the small economic farm holding, I venture to think, is the main small holding question. At present it affects a large class of the community, for, apart from new holdings of this order which may be brought into being, there are hundreds of thousands of such holdings existing in the United Kingdom. In this connection, therefore, I wish to consider the following points:—

(1.) The statistical evidence as to the number and size of small holdings in Great Britain and Ireland.

(2.) Certain changes in agricultural economic conditions affecting the small holding problem, especially (*a*) the shrinkage of the area of tillage, (*b*) the increase in agricultural imports, and (*c*) the changes in agricultural prices.

(3.) Conditions essential to the economic development of a small farm holding.

The author has drawn largely on Irish evidence and statistics, partly because they are more familiar to him, and partly because Ireland is pre-eminently a country of small holdings. These points are fully considered in the paper with the following results.

* Abstract of a paper by Mr. W. G. S. Adams, M.A., entitled "Some Considerations relating to the Position of the Small Holding in the United Kingdom," which was read before the Royal Statistical Society on 18th June.

1. *Size and Number of Holdings in the United Kingdom.*—In considering the number and size of holdings in the United Kingdom, it will be remembered that the statistics of the number and size of holdings in Great Britain deal only with the areas of cultivatable land, *i.e.*, the area under crops and under pasture, excluding rough and mountain grazing, whereas in the case of the statistics of the size and number of holdings in Ireland the total area of the holding is included, whether that area be of cultivatable land, rough grazing, waste mountain, or the area occupied by buildings. As a result, the contrast between the number and size of holdings in Great Britain and in Ireland is more marked than would appear from the published statistics. Out of 401,445 holdings exceeding 5 acres in Great Britain, no less 232,966 had a cultivatable area of between 5 and 50 acres. If even a considerable allowance is made for farms consisting largely of mountain and rough pasture, it is evident that the number of small holdings in Great Britain is very large, and that the question of the economic position and the extension of these holdings is of wide interest.

2. *Changes in Agricultural Economic Conditions.*—Three main lines of evidence must be referred to:—(1) The changes in the area under tillage and in the numbers of live stock; (2) the increase in agricultural imports; and (3) the movements of agricultural prices. These three points are intimately connected with one another, and bear jointly and severally on the small holdings question. For a good system of small holdings involves an increase in tillage, and the development of agricultural imports and the changes in agricultural prices are among the best tests as to the state of supply and demand in regard to the classes of produce which must be the staple of the small holder.

With regard to butter, the value of the annual imports shows the enormous field which there is for development in the United Kingdom. This, however, involves, if profitably carried out, the improvement of the milk production of our cows—as has been the case in Denmark—and, with an extended crop area, an increase in the number of cows. With regard to the prices of butter, while it is very difficult to compare present-day prices with those of past years, owing to the much greater differentiation which has taken place in agricultural produce, it is clear that the good qualities of butter are realising remunerative prices, and that, for the higher grades of butter, prices have been rising in recent years. There are creameries which are obtaining 1s. per pound for their butter the year round, and, at the same time, there are butters which are only realising half this amount. Anyone who has looked into the question of the prices obtained for butter in different parts of the country, and the astonishing difference there is in the quality of the butter and the causes of this difference, must feel that there is room for great improvement in the butter production of the United Kingdom. But in order to supply to a large extent our demand, and to obtain more remunerative prices, winter dairying must be developed, and this again depends on the extension of the area of winter-feeding crops.

To a somewhat less extent than in the case of butter, grading has affected the comparison of the prices of eggs, but whether one regards the import figures of the past twenty years, or whether one looks to the record of home prices, there is evidence of an upward tendency in the price of eggs. Every year since 1902 has shown better prices being obtained for Irish eggs. Again, it is plain that the output of eggs in the United Kingdom could be enormously increased. So far as Ireland is concerned, there is evidence that it is at the present time steadily advancing, and the export in the year 1904 exceeded a value of £2,000,000. What is true of eggs is true of poultry, and, in general, of all classes of fresh produce. The system of grading has led to better prices.

Considering on the one hand the demand for agricultural produce, as shown by the quantity imported and by the range of prices, and, on the other hand, the economic conditions which determine production as amongst the various competing countries of to-day and of the immediate future, the conclusion to which one is forced is that the future of agriculture in the United Kingdom, especially in the case of the small holder, must depend to an increasing extent on dairy produce, eggs and poultry, fruit, vegetables, and perishable produce, as well as on the production of the best grades of beef. Behind all this the fundamental question is the growing of grain, roots, and green crops, which are the raw material of all the animal produce.

3. *Conditions Essential to the Economic Development of a Small Farm Holding.*—The further question which remains for consideration is that of the capacity of the small holder as a producer and the essential conditions for him of economic production. It is a matter of considerable difficulty either to ascertain what might be regarded as the present average productive capacity of an agricultural small holding or to set up what may be considered a high but nevertheless attainable standard of production. If this is to be done it is necessary to define the size and type of small holding and then to obtain as complete a balance sheet as possible of expenditure and income. Inquiries which have been made in Ireland into the average productive capacity of, for example, the 20-acre farm, show how difficult it is to obtain correct and complete information regarding the average production and cost of such farms. In some cases, reckoning up the various items of expenditure and income, the small holder of 20 acres of average land appears to have only a balance of £30 to £40—plus a house, as net income - after interest on capital has been deducted. In other cases the net income runs from £60 to £70. The small holding is thus a business in which both industry and wise management are essential to success, and the more one studies the economic position of the small holder and sees the forces with which he has to compete

and the limited income which he can realise, the clearer does it become that the problem of the success of the small holder is largely the question of the man. We require the small farmer who has got into his head the sense of comparative values. For the economy of the small holder depends on whether you are going to have the man who sees to it that he has cows and feeds them to give him 800 gallons of milk rather than 400, that he keeps only those hens which give him 140 eggs and not 80, that he gets 10 tons of potatoes to his acre instead of 5, that he joins with others to buy and sell on the most economic lines, that he grows to a large extent his own food and his beasts food, that he feeds his cattle and pigs rationally, and, in a word, that he is alive as an individual to all the small economies, as well as the larger ones, which contribute to prosperity. This question of the man is absolutely at the root of the whole question of success or failure. And it is for this reason that, in view of the remarkable changes and advances in the scientific and the economic conditions of present day farming, that a thorough system of rural education and organisation must accompany the providing of facilities of land and capital for small holdings.

RICE MANUFACTURE.*

The conditioning, husking, and cleaning of paddy, or "the manufacture of rice," as it is briefly termed in America, being associated in this country with the cultivation of paddy, has so far received very little attention; but in America, Burma, and Siam it is worked as a manufacturing industry, which is the more correct system, as the processes relating thereto are quite distinct from the agricultural operations connected with paddy. This system of separating the agriculture and manufacture of a great produce has been adopted in India with regard to wheat, and there are sufficient grounds for introducing it in the case of paddy. The manufacture of rice in this country is an extensive industry. The value of rice produced here far exceeds the value of all the other agricultural produce of India put together. At the opening of the Pusa Institute, the Revenue and Agricultural Member Sir Denzil Ibbetson said that he calculated the total value of the agricultural produce of India to be £349 millions, and the "Agricultural Statistics of India" shows that about 29 million tons of rice, valued at £190 millions, are annually prepared in this country. The preparation of rice is, therefore, the most valuable manufacturing industry in India, and if the statistics of other great manufactures were examined, I should not be surprised if it turned out to be the most valuable manufacturing industry in the world. This enormous industry is, however, being conducted at present on the most primitive methods which are extremely slow, laborious and expensive, to persist in which would not be sound economy. Apart from the question of reducing the cost of production and thereby lowering the price of the staple food of this country, when you consider the vast amount of time and labour wasted on this industry which may be more profitably employed in others—of which the cultivation and manufacture of cotton may be named—you will agree with me that our industrial economics is still in a very backward condition and urgently needs a proper adjustment. Public attention has already been drawn to this manufacture by the *Statesman* newspaper. Considering the vastness of the industry, and the bright vista of economic possibilities it opens up before us, I think this subject commends itself to our very serious consideration. Having manufactured rice for a few years in this province, I think I am able to form some idea of the improvements that may be made in this industry.

The indigenous method of rice preparation, in which the pounder (*dhaki*) or the mortar and pestle (*hath-masuli*) plays an important part, is too well-known to need description. The method, apart from being extremely crude, tedious, and expensive, does not yield a clean produce free from impurities. The average cost of preparation by this method is 6½ as. [1 anna = 1d.] per maund [1 Madras maund = 25 lbs.] of rice, considering the low value of agricultural labour in this country. This cost increases to about 7 as. for boiled (*ushna*) rice and decreases to about 6 as. for unboiled or sun-dried (*alloh* or *attob*) rice. The working time required by one person to prepare a maund of boiled rice by this method is about 21 hours. This is made up as follows:—1 hour for paddy-clearing, ½ hour for putting into and taking out of water the paddy (the soaking which occupies about 24 hours requiring no attention), 2 hours for boiling and 1½ hour for drying it (although the paddy remains in the sun for about 5 hours) one person working all this time. The husking and cleaning of the paddy in the Dhaki is always done by two persons who would together take about 8 hours. For purpose of calculation this would be equivalent to 16 hours for one person, making up a total of 21 working hours. Similarly, a maund of unboiled rice would take about 1 hour for clearing, 1 hour for drying and 16 hours for husking and cleaning, making up a total of 18 workiug hours. Calculating the value of the labour at 3 as. per day of 9 working hours, the cost of 21 hours' labour would be 7 as. and of 18 hours' 6 as. being respectively the cost of preparing boiled and unboiled rice. This average cost of 6½ as, also coincides with the rate paid to hired-workers for rice preparation in certain parts of Bengal which is generally 6 as. per maund of rice, the worker retaining the half a maund of husk which may be valued at half an anna.

Before going further into this subject, it may be mentioned that the cost of rice manufacture varies mostly with the qnality of the rice wanted whether boiled or unboiled, polished or unpolished, but that it

* Paper read before the Second Indian Industrial Conference by Mr. Henry H. Ghosh, Calcutta.

also varies slightly with the quality of paddy used. In coarse paddy, the cost is somewhat lower than in fine paddy. The aforesaid cost is for medium qualities only. It may also be observed that a maund of medium quality Bengal paddy would yield about 26 seers of rice, 13 seers of husk (*thush*) and 1 seer of meal (*kuro*); and that the yield of rice increases slightly in coarse paddy and diminishes somewhat in fine paddy.

It would not be possible for me to state within the limits of this paper, the principles upon which rice is manufactured in America and Burma, but I shall here describe in the briefest outline a fairly efficient and economic system by which rice manufacturing may be initiated in this country. This system is very similar in most of its processes to either the Rangoon or the American system, and I may add that I have attained rather satisfactory results from it.

Conditioning.—The Separation of Refraction.—However much Bengal paddy is fanned at the time of purchase there is always a certain per-centage of refraction in it, such as balls of mud, bits of stick and straw, which have to be separated from the grain. When unboiled rice is wanted this is done by a "circular-motion separator," as in Rangoon. This separator consists of a set of sieves circulating in one plane, and requires very little power to drive. When boiled rice is wanted, the separation of refraction is effected by specific gravity in the soaking process.

The Soaking Process.—Previous to being boiled, paddy is soaked in fresh water for about 24 hours which softens the husk and clears it of all admixture. The balls of mud dissolve in the water, the paddy sinks to the bottom of the vat and the bits of stick and straw float up which are then easily removed.

The Boiling Operation.—The paddy is then partially boiled which renders the rice wholesome from the consumer's point of view and facilitates the husking process from the manufacturer's standpoint as we shall presently see. Par-boiling is done over fire in the indigenous method, but I have found that when effected by steam the operation becomes infinitely quicker, far less laborious, and more easy to regulate. This is done in a boiling apparatus where steam is introduced by means of a connecting pipe. No water is needed and decidedly better results are obtained.

The Drying Process.—Whether for boiled or unboiled rice, paddy is dried in the sun by the indigenous system to facilitate the husking operation. How boiling and drying helps the husking is easily explained. Boiling inflates, and drying contracts the body of the grain, the resultant of these two actions is to partially release the husk. Drying alone has this effect to a very slight extent. Unboiled paddy takes about three hours, and boiled paddy about five hours to dry in the sun, but the grain must be stirred now and again.

I may now say that the question of drying boiled paddy has always weighed heavily on the minds of those acquainted with this industry, and interested in its development. In this country there is a very extensive consumption of boiled rice, the unboiled rice being used by very poor people who find it more sustaining. In Burma also both kinds are prepared, perhaps more of the latter, as her exports are of this sort. But in America only unboiled rice is manufactured. This difference of quality is due in a great measure to the various purposes for which the rice of these countries is required. Indian rice is used exclusively for food, Burma rice for food, distillation and starch, and American rice for food and confectionery. But I fear that the difficulty of drying has been greatly exaggerated in this country. Because by the indigenous method even unboiled paddy is dried in the sun before being husked, an erroneous idea prevails among some of us that this process would be needed for this paddy if husked in the machine. But such would not be the case, for both in Rangoon and America unboiled paddy is husked in the mills without any previous process of drying; and various qualities of Bengal paddy, unboiled and without any special drying, have been husked very satisfactorily in the Engelberg and Cowie's Hullers. Of course, it is always understood that well-matured and naturally dried paddy is to be put in the husking machine. The only question with us, therefore, is the drying of boiled paddy. This can always be conducted under a tropical sun to a limited extent. I have myself dried boiled paddy regularly in the sun on a large platform which I am told is also done at the Coconada Rice Mills. Daily a hundred or two hundred maunds of grain can be conveniently dried in this manner if there is sufficient ground for the purpose. But the treatment of larger quantities in this way would become rather cumbrous. Attempts have therefore been made to dry boiled paddy artificially both here and in Burma, but none with any satisfactory result. Hot air has been always used in the process, and though the drying has been somewhat successful, the colour of the rice has never been as clear and white as that of the sun-dried grain. But there is no reason why we should give up hope in this matter when tea and particularly wheat, about the colour of which consumers are very fastidious, are now being artificially dried. Indeed, I believe it is Gibb's wheat dryer that has showed the best results with paddy up to now. and it is quite possible that Messrs. Thomas Robinson and Son, Ltd., of Rochdale, makers of the celebrated Mallinson's Wheat Dryer will be able to present a perfect paddy-dryer if they find a market for it. I may here mention that Mr. Rakhal Dass Khan, rice-huller maker, of Sulkea, has recently suplied to a Chetlah miller a paddy dryer which dries boiled paddy with a certain amount of success. But it does not treat more than about 40 mds. of grain in 8 hours, four coolies working at it. As it stands, therefore, his process is no better nor cheaper than the sun-drying process.

After treatment in the aforesaid manner, the paddy is brought to a condition fit to be husked. There are several machines on the market for preparing rice. In England, rice mill machinery are constructed by Messrs. Hind and Lund, Messrs. William R. Dell

and Son, of London, and other makers. In Germany, F. H. Schulze, of Hamburg, manufactures rice plants, notably a polishing machine which is called his "Pearler." It is, however, noteworthy that some of the best rice-milling machines come from America and Burma.

Husking. —The principle by which paddy is husked in the indigenous method, and which is followed up in all husking machines, is the application of friction and pressure. On a small scale the most complete and satisfactory husking machine is the well-known Engelberg Huller No. 2, which husks about 60 mds. of medium Bengal paddy in eight hours. The price of huller is Rs. 700. Mr. Rakhal Dass Khan of Sulkea has also constructed a rice huller which I believe is giving satisfaction to a Chetlah miller. I am told that it husks about 40 mds. of paddy in eight hours, and only costs Rs. 300. The cost of replacing wearable parts is little compared to the expense of changing the blade and screen in the Engelberg. Khan's huller is therefore well worth a trial. As for the hullers constructed by the late Jogodiswar Ghatak, I regret I am unable to say anything in their favour. But the husking machine that has so far given the best results with Bengal paddy is Cowie's huller, made in Rangoon. The machine entails the erection of a plant (with double fan, elevator, and direct-acting sift), which cannot be done with a small capital. The outturn of this huller, made in different sizes, ranges from 100 to 200 mds. daily of brown rice.

Cleaning.—When paddy is husked it is technically called "brown rice," owing to the brown coating below the husk which now appears. The removal of this coating is called the cleaning process, in which there is more friction applied than pressure. A good cleaner for a small mill has not yet been put on the market. Engelberg Huller No. 1 is about the only machine that serves the purpose if the skin in its lower cylinder is replaced whenever it wears out. Unless this is done the rice gets slightly discoloured. The White Rice Cone made in Rangoon is, however, an excellent cleaner, the product from it satisfying the most exacting market. It has a large capacity, but is an expensive machine.

Polishing.—When brown rice is cleaned it is technically khown as "white rice." Polishing is the process by which the surface of white rice is glazed. This treatment is only necessary for rice that is exported. Schulze's Pearler has turned out perfectly polished rice at the Ramkristopur Rice Mills Ld.

Rice cleaning and polishing, which is a portion of the industry here advocated, is not new to the country. This system of rice milling entirely for the export trade has been carried on for several years at Ramkristopur and Chetlah near Calcutta, and the complete manufacture of rice is now conducted by a handful of millers scattered about in North Western India and the Madras Presidency. But the only reason I can attribute to the slow growth of the industry is that, unlike the other countries, boiled rice is largely consumed here and the difficulty of paddy drying has always loomed very large in the minds of those that have from time to time been enquiring about it. Had they been reasonable in their apprehensions, the problem of drying might have been solved ere this. I have often tried to correct false notions regarding this industry but my endeavours have been futile.

By the system above stated the cost of rice preparation per maund would be approximately 2 as. 6 p. [2½d.] for unboiled and 3 as. for boiled rice, unpolished, such as would be needed for home consumption. Rangoon millers reckon an average of 3 as. as the cost of preparing polished rice. If a system of artificial drying is introduced, the cost of boiled rice should be reduced by 6 pies approximately. It will, therefore, be evident that by the introduction of the Rangoon and American systems of manufacture, the price of the greatest staple food of our country will be reduced by about four annas on the maund, and an enormous quantity of labour will be set free for more profitable industries.

TRANSPORTATION OF FRESH FRUIT FROM HAWAII TO THE UNITED STATES.*

An opportunity having arisen, it gives me pleasure to write on a subject which is not only of interest to my country and its people, but may also be of interest to the Society of Arts and to the commercial world at large, from the fact that these mid-Pacific Islands, mere specks in the map of the world, are now an isolated insular possession of the United States of America. What follows will also go to show that the people are alive to their own and their country's interest and welfare.

During the session of the Fourth Territorial Legislature, which prorogued, or as the term now in use, adjourned *sine die*, on the 1st May, a Bill was introduced in the House of Representatives by the Honourable Charles Akau, a native Hawaiian member from the First Representative District, Island of Hawaii, on April 4th last, entitled "An Act to promote, provide for and regulate cheap and proper transportation by land and sea of fresh fruit and other fruit from certain points of the territory of Hawaii to the Pacific coast of the United States of America, to provide for and superintend the sale thereof and to authorise the making and promulgation of rules and regulations in connection with the objects aforesaid and the penal enforcement thereof."

The said Bill passed through all the necessary legislative stages both in the lower House, its place of origin, as well as in the upper body, the Senate, finally going to the Governor on the 1st instant, who in turn failed to give it his approval by pocket-vetoing the same.

* Communicated by Mr. F. J. Testa, of Honolulu, Member of the Society of Arts.

At the second reading stage in both branches of the Legislature, the House Committee on Agriculture, Manufactures, Forestry Promotion and Immigration, reported favourably, which report was adopted. In the Senate an oral report was made by the Committee on Ways and Means, and upon motion being thereto made it readily passed the second reading; the third reading following, as a matter of course, upon recommendations thereto respectively made. The House amendments were made on the second reading, and those by the Senate on the third reading respectively, the latter's amendments being readily concurred in by the House upon its return on April 30th, the Bill, as amended, being finally transmitted to the Executive as before mentioned. Thus much for the legislative action taken upon the measure.

Much has been written and said in the past, and chiefly since annexation, about "diversified industries" and "small farming," as well as the creation of interest in having our unoccupied lands replete with "settlers" and "homesteaders." Laws were heretofore enacted, as well as during the recent Legislature, to aid and encourage diversified industries by exempting the lands for the cultivation of certain commercial products from taxation for a stated number of years.

The aid and encouragement was first adopted in 1903 by the exemption of "sisal fibre, castor oil, vanilla extract, Hawaiian starch, pineapple, and Manioca starch (Kasawa);" in 1905, this list was enlarged by the addition of "tobacco, rubber, cork oak, Manila hemp, sansaveria salonica hemp, and cacao," and in "copra" and "grapes for the manufacture of wine" (the whole list being specifically "for commercial purposes") were further added. An attempt was made to place coffee on the list, but this did not pass. Few, indeed, have availed themselves of this advantage, the chief and greatest drawback being the market and transportation, facilities being few and far between.

Local markets are few and the demand limited. Transportation is the most difficult feature in the whole situation. Homesteaders are settled at distances from the landings, so that travelling is generally accompanied by hardship and much labour, the whole being costly and expensive, and by the time the products arrive at their destination, and when returns come in, the receipts are insufficient to pay expenses, including time wasted and labour lost. It is thus that the poor man, or the man of small means, is forced to give up in disgust. While no money can be made, still a meagre living might be eked out by those more persevering and a home ensured. But how many care to eke out a precarious existence in such manner, even in this far away portion of this universe, enriching only the handlers and the transporters, besides those who are already rich, backed by large capital, and ready to cramp and freeze out those unable to help themselves any further on the road downwards. Some few, exceedingly few, have come out with enough for the "rainy day," and they are only those who have held on and disposed of their holdings, or interests, to the larger industry (sugar).

The object of the Bill is to aid and encourage the man of small means by supplying him with a market for his products, as well as the means of transporting the same, for the measure carries a subsidy with it. Probably it was this subsidy that caused its rejection by the Governor, he having called attention in some of his veto messages to various measures introduced this session carrying special items of appropriation.

In my opinion, the measure (House Bill No. 196 herein enclosed and referred to) should have become a law this time, and should it be a "dead letter" even during the interregnum, it could have given the Government, say, two years at the most, to work on the matter for final ratification at the next Legislature in 1909. It certainly was an important measure to the upbuilding of the country, and a great step forward in our material development.

The introducer, a young man and a native like your correspondent, desired not to push it, being content to let it rest till the next session.

Honolulu, May 15, 1907.

THE BILL REFERRED TO ABOVE.

An Act, to promote, provide for, and regulate cheap and proper transportation by land and sea of fresh fruit, vegetables, and other freight, from certain points of the territory of Hawaii to the Pacific Coast of the United States of America, to provide for and superintend the sale thereof, and to authorise the making and promulgation of rules and regulations in connection with the objects aforesaid and the penal enforcement thereof.

Be it enacted by the Legislature of the territory of Hawaii:—

Section 1.—The Board of Agriculture and Forestry, by and with the consent of the Governor, is hereby authorised to negotiate and enter into a contract for a term not exceeding ten (10) years with any responsible person or persons and corporation or corporations jointly or severally to promote, provide for, and regulate cheap and proper transportation by land and sea of fresh fruit, vegetables and other freight from any station (present or future) at and from any point throughout the territory, or from any harbors therein, to the port of San Francisco and all other ports on the Pacific Coast of the United States of America, and to contract and agree with such person or persons, and corporation or corporations, for and in the name of the territory; to pay by way of subsidy to such person or persons, and corporation or corporations, a sum not to exceed fifty thousand dollars ($50,000) annually during said term.

Section 2.—The purpose of this Act is primarily to stimulate and build up the cultivation and transportation of fresh fruit and vegetables from this territory to the mainland of the United States. It is further declared essential to secure the aforesaid result that all fruits and vegetables transported

under the provisions of this Act shall be well packed and of standard quality and size and pass Government inspection to entitle the owners thereof to transport the same under the provisions of this Act; that depots or stations at short distances apart may be established wherever deemed necessary where fruit and vegetables may be left by the growers thereof for through transportation; that a cheap through rate from said stations to the Pacific Coast be obtained; and that said fruit and vegetables be adequately and specially equipped and prepared and otherwise fit for transportation. If the supply of freight offered exceeds the means of transportation at any one time, that the offerings of fresh fruit and vegetables shall be given preference over other freight, and the offerings of fruit and vegetables by small holders be given preference over other offerings of fruit and vegetables; and that the territory maintain an agent upon the coast to maintain proper prices for fruit and vegetables; promote the advantageous transportation thereof inland from the Pacific Coast ports and the prompt sale thereof. And the Board of Agriculture and Forestry is hereby directed by and with the advice and consent of the Governor to contract as far as practicable so as to secure to said fruit and vegetable growers the protection, benefits and means and method of transportation outlined and set forth in this section.

Section 3. — The Board of Agriculture and Forestry, by and with the consent of the Governor, is authorised to make and promulgate all necessary and proper rules and regulations controlling the selection and transportation of fruits and vegetables; the receipt, transportation and delivery thereof to Pacific Coast ports; the transportation and sale thereof after arriving at such ports, speedy and cheap enforcement of damage claims by shippers and all other matters and things to be done or performed under the provisions of this Act, and to provide penalties for the non-observance of such rules and regulations, and for the enforcement of such penalties. Such penalties, which shall be enforcible penally, shall be limited to fines and shall not in any case exceed two hundred dollars ($200) for any one violation of such rules and regulations.

Section 4.—This Act shall go into force and effect from and after the date of its approval.

THE DEVELOPMENT OF JAPANESE SHIPBUILDING.

The war has given a great impetus to the shipbuilding and dockyard industry in Japan, which has made remarkable progress during the last few years. The principal shipbuilding yards are at Osaka, Kobe and Nagasaki, and all three are full up with orders. The total area of the Osaka yards is about 34 acres, and about four thousand men are employed. The Kobe yards have a factory area of over 50 acres, and employ eight thousand workmen. The Nagasaki yards are the largest in the country covering some 80 acres of land, and employing over ten thousand men. These shipbuilding yards, however, find their capacity inadequate to meet growing requirements, and are steadily engaged in extending their works. The factory arrangements have much improved. The building of torpedo destroyers is quite a new feature. Already one of these has been launched at Osaka, four at Kobe, and two from Nagasaki. The construction of gunboats for the Chinese Government is going on at Kobe, two of them having already been launched. The building of ships of over 10,000 tons in Japanese yards is now quite common. At Nagasaki, a ship of 13,000 tons is being built for the Toyo Kisen Kaisha, in addition to a ship to take the place of the *Hitachi Maru*, which was destroyed by the Russians during the war. According to the United States Consul-General at Yokohama, work in the smaller yards has also greatly increased since the war. The small shipyards on both banks of the Kidzugwa have hitherto devoted their attentions to the building of wooden vessels of 200 to 300 tons, but these are now able to build iron ships of 800 tons. The yards at Kayokijima, outside Nagasaki harbour, which have hitherto been engaged in repairing work, are fast developing into a complete shipbuilding yard. At Innoshima, Bingo, there are two dockyard companies, one of which possesses two docks, measuring 300 feet and 364 feet respectively, while the other has a dock 410 feet in length, and is about to open another, measuring 300 feet. At Nochi and Kinoe there are two shipbuilding yards, and possessing a dock 200 feet in length. Kinoemaru has long been known as a centre of wooden shipbuilding, and the launching of a ship of from 70 to 150 tons is of very frequent occurrence. The largest dock in Japan is at Nagasaki, which measures 728 feet. The next being at Yokohama, with a dock of 552 feet; the third largest at Hakodate, being 534 feet long. The floating dock, owned by the Nagasaki Company, is 412 feet in length, and is capable of floating a dead weight of 7,000 tons. Another and larger floating dock is now being built by the same company. The docking business, like the shipbuilding, is now in a very prosperous condition in Japan. The technical knowledge of shipbuilding among the Japanese has also made progress, compared with eight or nine years ago, when the *Hitachi Maru* (6,000 tons) was built. At that time, the engineers and mechanics experienced difficulty in building the steamer, but now they are able to build larger vessels with greater ease and expedition. What is necessary in Japanese shipbuilding is the further subdivision of labour among the various departments of the industry. If this is done, shipbuilding can be executed with more despatch. There is scarcely any doubt that with the devefopment of the shipbuilding industry in Japan orders from foreign countries will increase. Subsidies are given by the Government on all ships constructed in Japan for the Japanese. The sum fixed

in the budget for the current fiscal year, under the heading of encouragement to shipbuilding, is only £73 000, which is exclusive of sums paid to existing steamship lines, and Tokyo papers say that it will prove quite insufficient. Speaking broadly, the rate paid for vessels built in Japanese dockyards, and satisfying the required tests, are £2 per ton for the hull, and £1 per horse-power for the boilers. Fourteen vessels, aggregating 55,488 tons, will come within the scope of the provisions, and the subsidy will amount to £230,000, or £240,000, so that there will be a deficiency of something over £150,000. The Government will probably pay it out of the reserves, and embody it in a supplementary budget for the approval of the Diet next session. The tonnage under construction amounts to 55,488 tons for the fourteen vessels ordered. In addition, the Nippon Yusen Kaisha have ordered six vessels of 8,500 tons each, and there are two ships building of 2,800 tons, which will not be eligible for bounty. Thus the total under construction is 22 vessels, aggregating 112,000 tons. A subsidy is paid to mail steamers sailing not only to Europe, America, and Australia, but also to lines engaged in the coasting trade in China, in connection with Japan. These steamers run to all of the important ports in China, going not only to Corea Dalny, Chefoo, Newchwang, Tientsin, Tsingtau Shanghai, and all southern ports, and to the Philippines, but they go 700 miles up the great river Yangtsze to Hankow. At the close of 1903, Japan possessed 657,000 tons of steamers and 320 tons of sailing vessels. In 1905, the steamer tonnage had increased to 939,000 tons, and the sailing tonnage to 336,000, making a total of 1,275,000 tons. The vessels include 338 under 5 years, 331 from 5 to 10 years, 257 from 10 to 15 years, 181 from 15 to 20 years, and 131 up to 25 years, thus leaving only 148 over 25 years old.

COAL PRICES AND EXPORTS.

The outlook for coal consumers throughout the country is far from promising at the present time, on account of the large increases in prices which have taken place in recent months, and which have no prospect of undergoing a reduction within a conceivable period. All classes of consumers, whether engineers, manufacturers, or railway and gas companies, together with users of coal for domestic purposes, are affected more or less by the upward movement, which started about the time when the export duty on coal was abolished at the end of last October, and which is very prominently connected with the transactions in foreign markets. The coal trade was one of the last branches to participate in the general improvement in manufacturing and industrial enterprises during the past two years, but it has made a considerable advance in a comparatively short period, and is doubtless producing a golden harvest for the coalowners. During the five years and a-half of the operation of the export duty on coal the impost yielded to the national exchequer, as recorded in a Treasury return, a total sum exceeding £11,000,000. Now, if this amount was paid by the coalowners or exporters, as has always been their contention, it will be obvious that the removal of the tax has released them from a very severe financial burden; but it is by no means certain that they were called upon actually to defray all, or any, of the shilling per ton duty on coal of the value of six shillings per ton and upwards. If, however, the coal owners' view of the position is accepted as the correct one, they are deriving a double advantage at the present time—first, by not having to pay the export duty; and, secondly, by reason of the large increase both in home and export prices. On the other hand, the wages of the coal miners in most of the producing districts have been raised in recent months, and industrial peace is assured in the federated area and in South Wales for the next two or three years, owing to the binding agreements between the coal owners and the miners. In May alone, according to the memorandum of the Board of Trade, no less than 270,000 coal miners received an advance in wages, or a total of nearly one-third of the aggregate number of miners employed throughout Great Britain.

The general improvement in the trade of the United Kingdom, and the increase in the wages of the miners, are not the only causes which are responsible for the augmentation in the prices of fuel to inland consumers, as the shipments to other countries have largely contributed towards bringing about the present situation of affairs. In fact, the period of industrial prosperity also prevailing in certain continental countries stimulated the exports of British coal during 1906, and it has continued to operate in this direction in the first six months of the current year. Even the defunct export duty, which the coalowners declared was hampering the trade, failed to arrest the progress of the shipments, seeing that the exports of coal increased in every financial year during the time the tax was in force. The abolition of the impost at the end of last October only left two months of 1906 free from its operation. Yet the total exports of coal in that year, exclusive of bunker fuel, amounted to 8,400,000 tons in excess of the exports in 1905, which in turn exhibited an increase of 1,100,000 tons over the preceding year. But exceptional circumstances existed in 1906 on account of the industrial prosperity in Germany, Belgium, and Italy, and the disaster at the French colliery at Courrières, and the subsequent general strike of coal miners in the Nord and the Pas de Calais. It was consequently possible for exporters to maintain the exports of coal to Germany at 7,600,000 tons in 1906, or practically the same quantity as in the preceding year, which was specially advantageous to British exporters owing to the strikes of coal miners both in Germany and Belgium. An enormous advance of 2,700,000 tons took place in the coal shipped to France in 1906, and augmentations were also recorded in the case of

Italy, Holland, Belgium, Sweden, and other countries. The progress has continued this year, and in he first five months the exports show an increase of 2,100,000 tons over the corresponding period of 1906, of which about 80 per cent. represents additional quantities forwarded to Germany, France, Holland, and Belgium.

The continued expansion in the exports of coal is, without doubt, a gratifying event to producers, although, it is to be feared, that in the promotion of the foreign trade in this raw material the needs of home consumers are not receiving all the attention they deserve, especially in the matter of prices. It is, perhaps, easy to understand the development of the export trade to countries which either have no native supplies of coal or an insufficient quantity for their own requirements, as, for instance, France, Italy, Spain, Holland, and certain other countries; but it is difficult to comprehend why every endeavour should be made to increase the exports to any country which has ample supplies of fuel within its own frontiers, when by so doing the exporters cannot derive any permanent advantage. Year in and year out during the present century our coalowners have complained of German competition and loss of markets, and they have, in some cases, been supported by consular statements recording arrivals of German coal at foreign ports. While losses may have been incurred in particular cases, the export trade, as a whole, has not suffered, as is demonstrated by the annually increasing tonnage of shipments. But the coal exporters themselves, unconsciously as it may appear to them, are simply placing facilities in the way of their German rivals, as every ton of coal forwarded to Germany releases a ton of German coal for the export market. In other words, if less British coal were sent to Germany, the latter country would be compelled to use at home a larger quantity of its own production instead of exporting it. It is unfortunate that British coalowners have failed to recognise the importance of the weapon with which they have armed their commercial rivals, and which they are now strengthening month by month. Certain classes of users have to pay for the privilege of involuntarily supporting this reckless competition, and it is, perhaps, not going too far to assert that all consumers at home are being drawn upon to contribute heavily towards it at the present time.—*The Engineer*.

THRIFT IN AMERICA.

Some statistics published by the *Monetary Times* of Toronto, are interesting as indicating the progress of thrift in America. The habit of thrift is especially apparent there. Living is higher than in Europe, and wages are higher, but both the United States and Canada make a creditable show in the matter of savings' bank deposits. There are nearly 8,000,000 savings' depositors in the United States, the deposits amounting to more than 3,500,000,000 dols. At the close of 1906 the average savings in the United States was about 41·13 dols. *per capita*, based upon a total population of 84,500,000 persons, compared with 34·89 dols. *per capita* five years ago. The average amount of money due to each savings depositor at the close of the last calendar year was 433·79 dols., which compares with 412·53 dols. at the close of 1902. The savings depositors now represent a little more than 10 per cent. of the total population, which is double the number of ten years ago. In 1871 there were in Canada 231 post office savings' banks, and 17,153 open accounts with a credit of 2,497,260 dols. In 1905 there were 989 savings' banks, and 165,518 open accounts, with a credit of 45,368,321 dols., increases of 328 per cent., 865 per cent., and 1,713 per cent. In the same period the cash deposits of the Dominion Government savings' banks had increased from 556,669 dols. to 2,817,267 dols., a gain of 2,260,598 dols., or 406 per cent. Taking the business of the post office and Government savings' banks together, the total deposits in 1886 were 15,158,296 dols. In 1896 this sum had decreased to 11,882,307 dols. In 1905 it showed an increase, the total deposits then being 13,574,471 dols. But while the annual deposits of the Government savings' banks have declined during the past twenty years or more, those of the post office savings' banks, until the past two years, increased steadily. The policy of the Dominion Government is to close their savings' banks as occasion offers. A little over a year ago there were twenty-three Government savings' banks, now there are only nineteen. In a few years there will probably be only three or four. Of late years the annual deposits of the post office savings' banks have been less than the annual withdrawals, the figures for 1905 being 10,504,430 dols. and 12,129,101 dols. respectively. Much of the money withdrawn from the Government banks finds its way into the coffers of the chartered banks. They offer the public advantages which the Government institutions do not. For example, the depositor with a bank may obtain his savings without notice. Then again the Canadian banks advertise largely and there is keen competition for business. There are thirty-five chartered banks in the Dominion each striving for the best business. The deposits of the Government savings' banks in the last twelve months declined to the extent of ·2 per cent., while those of the chartered bodies gained by 10·5 per cent. The Government have some thousand offices in which to transact the savings' bank business, the banks have some 1,700 branches in Canada. At the end of March the Government savings banks' accounted for 14,766,828 dols. deposits, while the post office savings banks held 46,897,724 dols. The March bank statement shows deposits in the chartered banks of 657,961,220 dols.

To summarise, the savings of the Dominion are held as follows:—

Deposits in	Dols.
Chartered Banks	567,937,052
Post-office Savings' Banks........	46,897,721
Government Savings' Banks	14,766,828
City and District Savings' Banks ..	19,945,511
Caissie d'Economie	8,414,108
	657,961,220

The following Table shows that bank deposits keep pace with the increasing population :—

	1891.	1901.	March, 1906.
Population (approximate)	4,833,239	5,371,315	6,371,315
	dols.	dols.	dols.
Total bank deposits ...	193,015,474	390,949,482	687,961.220
Deposits *per capita* ...	40	73	131

Against the figures of the United States the Canadian deposits *per capita* look well :—

	1905. dols.		1906. dols.
Canada	95	..	131
United States	39	..	41

Canada is not only very prosperous, she would seem to be very thrifty.

MUD-BINDING GRASSES.

The following notice from the *Kew Bulletin* (No. 5, 1907) bears upon the subject of some of the remarks of Lord Montagu in the discussion on Mr. A. E. Carey's paper on Coast Erosion (see *ante* p. 664).

The question of sea-defence work, now occupying the attention of the Royal Commission on Coast Erosion, is one of great general interest. Much has been recorded with regard to mechanical devices for arresting the removal and promoting the accretion of shingle, while the preservation and fixation of dunes by sand-binding grasses and other sand-loving plants has been dealt with so often that the subject now possesses a voluminous literature of its own. This literature has been fully summarised by Gerhardt in "Handbuch des deutschen Dünenbaues,"* pp. 629–644, Berlin, 1900, to which reference may be made by those who may desire full information on the subject.

The latest and one of the most comprehensive accounts of sand-binding grasses enumerated by Gerhardt is that by Mr. Lamson-Scribner, published in the "Year Book of the United States Department of Agriculture for 1898," pp. 405–420. A perusal of this paper may be recommended to all who desire to find the salient facts clearly presented in a concise manner.

* Handbuch des deutschen Dünenbaues im Auftrage des Kgl. Preuss. Ministerium der öffenlichen Arbeiten und unter Mitwirkung von Dr. Johannes Abromeit, Paul Bock, Dr. Alfred Jentzsch, herausgegeben von Paul Gerhardt; Berlin, 1900, pp. i.-xxviii., 1-656, with 445 figures in the text.

As compared with the effects of vegetation in preserving sandy shores and fixing sandy foreshores, the action of plants in assisting the accretion of mud and in fixing and preserving muddy foreshores has received comparatively little systematic attention. A sketch of these processes as they present themselves in the great Gangetic delta has been given in the "Records of the Botanical Survey of India," vol. ii., No. 4, pp. 231 *et seq.*,* and incidental allusions to the subject are to be found scattered throughout the literature of topographical and geological botany. The subject is, however, one that is of much interest everywhere from the purely scientific point of view, and one that even in this country may be of considerable practical importance.

Giving evidence before the Royal Commission on Coast Erosion, Lord Montagu of Beaulieu is reported as follows: "The mud banks on his property had gradually been increasing very rapidly. The accretion was due to a somewhat extraordinary fact. Some years ago a ship came up Southampton Water from the River Plate with a quantity of rice-grass on board. The seeds of this grass became distributed about the shores of Southampton Water, with the result that the whole of that estuary was now covered with this grass. It was a plant which grew very rapidly and spread in circles, and now the twenty miles from Hurst Castle to Southampton were covered with this grass, as were the mud-banks on his foreshore. The stiff and sharp points caught the seaweed which came over it, causing the bank to increase rapidly in height . . . . . There was no knowledge of the grass, so far as he could understand, up to ten years ago."

To anyone knowing the vegetation of the coast of Southampton Water, it was evident that the grass in question must be a member of the genus *Spartina*, though the names "rice grass" and "sea-rice" are unknown in botanical literature, and unknown, we believe, to those most versed in the popular names of British plants.

* See especially a reference to the action of *Oryza coarctata*, Roxb., at p. 357.

INTERNATIONAL CONGRESS ON SCHOOL HYGIENE.

The second International Congress on School Hygiene will be held in London in August next. The meeting promises to be thoroughly representative and international, and it is believed that it will serve a useful purpose by calling public attention in this country to the need for cultivating healthy conditions in child life, by which means the danger of deterioration of the race can be averted.

The first Congress held at Nuremburg in 1904 was very successful, and the large number of foreign visitors, which included a representative deputation from Great Britain, were received and entertained in a most cordial and hospitable manner. The com-

mittee for organising the Congress in London feel that special efforts should be made to ensure that the second meeting shall be even more successful than the first, and to receive and entertain the large number of foreign and colonial visitors in a manner worthy of this country.

It is estimated that an amount of £3,000 will be required for the organisation and reception of the Congress, towards which only £1,300 has been subscribed. The committee appeal to those interested in educational matters and the physical welfare of the children to give their generous support to the Congress.

The President of the Congress is Sir Lauder Brunton, LL.D., M.D., F.R.S. The Sections, with their Presidents, are as follows: — 1. The Physiology and Psychology of Educational Methods and Work, Sir James Crichton-Browne, M.D., LL.D, F.R.S. 2. Medical and Hygienic Inspection in School, Prof. William Osler, LL.D., M.D., D.Sc., F.R.S. 3. The Hygiene of the Teaching Profession, T. J. Macnamara, LL.D., M.P. 4. Instruction in Hygiene for Teachers and Scholars, Sir William J. Collins, M.P., M.D., M.S. 5. Physical Education and Training in Personal Hygiene, Sir John W. Byers, M.A., M.D. 6. Out of School Hygiene, Holiday Camps and Schools, the Relation of Home and the School, Lord Kinnaird. 7. Contagious Diseases, Ill-health, and other Conditions affecting Attendance, Sir Shirley F. Murphy, M.R.C.S. 8. Special Schools for Feeble-Minded and Exceptional Children, W. H. Dickinson, M.P. 9. Special Schools for Blind, and Deaf and Dumb Children, the Right Hon. the Earl of Crewe, P.C. 10. Hygiene of Residential Schools, Clement Dukes, M.D., F.R.C.P. 11. The School Building and its Equipment, Thomas Edward Collcutt, Pres. R.I.B.A.

The lectures before the Congress will be:—

1. "The Effect of School Training on Mental Discipline and Control in Adolescence," by the Right Rev. Bishop Welldon, D.D., Dean of Manchester.

2. "Hygiene du Sport pour les Femmes et Filles," par Mons. le Dr. Doleres, des Hôpitaux de Paris, Membre de l'Académie de Médicine.

3. "Vortrag ueber Beziehungen zwischen Medizin und Paedogogik," von Prof. Dr. med. et phil. Griesbach, Vorsitzender des Allgemeinen deutschen Vereins für Schulgeshundeitspflege, Mülhausen (Elsass).

The set subjects for discussion at four general meetings, to be opened by English, French, and German speakers, will be:—1. Methods for the first and subsequent medical examinations of school children. 2. School work in its relation to: (*a*) The duration of the lessons; (*b*) The sequence of the subjects; (*c*) The season of the year. 4. The lighting and ventilating of class-rooms.

In order, as far as possible, to illustrate practically matters coming under the consideration of the Congress, an Exhibition will be organised and arranged in the University building by the Royal Sanitary Institute, in which the planning, construction, and equipment of school buildings will be illustrated, and school furniture and teaching appliances of all kinds exhibited.

The offices of the Congress are 72, Margaret-street, London, W.

ELECTRIC SMELTING OF IRON ORE.

Allusion was made some time back in the *Board of Trade Journal* to the researches of Dr. Haanel, Dominion Superintendent of Mines, into the question of the production of iron and steel in Canada by the electric process. It is now reported in the same journal from the *Iron Age* (New York) that Dr. Haanel has now presented to his Government a very full report on the results of the experiments in the electro-thermic smelting of Canadian iron ore which were carried out at Sault Ste. Marie early in 1906.

Under "General Remarks," Dr. Haanel expresses some of his most important conclusions. The very best of pig-iron can be made, he says, from Canadian magnetites that are too high in sulphur to be admitted into a blast furnace. He goes on to say:—"It has been proved that ores carrying as much as 1·5 per cent. of sulphur can be converted into the very finest pig-iron by electrical treatment. One fundamental condition, therefore, namely, an abundance of low-priced ore, can safely be calculated upon, as Canada has vast fields of sulphurous ores. Another fundamental condition is cheap water power. In no part of the world are natural water powers of more general occurrence than in Canada.

"With such a price for the energy required, the small consumption of electrode, the cheapness of the ore employed, and the peculiar excellence of the pig-iron produced, electric smelting of iron ores in Canada in properly constructed furnaces, using charcoal or peat-coke made from our peat bogs of enormous extent, may be pronounced commercially feasible."

The results of the experiments are summarised in the report as follows:—

1. Canadian ores, chiefly magnetites, can be economically smelted as hematites by the electro-thermic process.

2. Ores of high sulphur content can be made into pig-iron containing only a few thousandths of 1 per cent. of sulphur.

3. The silicon content can be varied as required for the class of pig-iron to be produced.

4. Charcoal which can be cheaply produced from mill refuse or from wood which could not otherwise be utilised, and peat-coke can be substituted for coke without being briquetted with the ore.

5. A ferro-nickel pig can be produced, practically free from sulphur and of fine quality, from roasted nickeliferous pyrrhatite.

6. Iron ores containing as much as 5 per cent. of

titanium can be successfully treated by the electrothermic process. This conclusion is based upon an experiment made with an ore containing 17·82 per cent. of titanic acid, a pig-iron of good quality being obtained.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department of the Admiralty in April and May :—

April.—New Charts.—3604—Baltic sea, Sweden, east coast :—Stockholm, Skärgärd, southern portion. 3640—France, west coast :—Anse de Benodet. 3654—North American lakes, Lake Erie :—Sandusky bay, eastern portion. 3627—South America, Magellan strait; anchorages in Martinez and Baker channels :—Port Merino Jarpa, Laguera cove, Port Valdes, Port Alvarez, Port Cueri Cueri, Port Valenzuela, Port Brown, Dewet cove, Port Tres Meses, Port Contreras, River Huemules, Port Quellehue, Port Francisco. 3634—Alaska; plans in Prince of Wales island :—McKenzie inlet, Hollis anchorage, Cordova bay and Hetta inlet, Dolomi anchorage and Port Johnson, North arm of Moira sound, Lyman anchorage. 3637—Alaska; plans in the neighbourhood of Chatham strait :—Red Bluff bay, Hoggatt bay, Herring bay and Chapin bay, Gut bay, Surprise harbour and Murder cove. 3653—Alaska :—Whitewater and Chaik bays. 3655—Plans in Alaska :—Resurrection bay. 593—Alaska, Yukon river to point Barrow including Bering strait ; plans :—Anchorage of Chamisso, Port Clarence and Grantley harbour. 3648—Africa, west coast :—Junk river to Cestos bay ; plan :—Grand Bassa. 1257—Korea :—Approaches to Ping Yang inlet and Yalu kiang, Choppeki point to Amunyoku kang (Yalu kiang). 3642—Korea :—A San anchorage and approaches. 3631—Japan, Kiusiu, west coast :—Yanagino seto and approaches. 3639—Japan, plans in the north part of Honshu (Nipou) :—Funakoshi wan, same anchorage, Fuku ura, Nezugaseki ko, Kuji wan. 3641—Australia, south coast :—Nepean bay. New plans and plans added :—472—Harbours and anchorages on the coast Häiti or San Domingo ; plan added—Port Jackson. 2406—Ports in San Domingo plan added :—Port Rincon. 2194—Sketch plan of anchorages in the eastern part of the Celebes ; new plans :—Parigi road, Muton road ; plan added :—Labua sore. 2718—Anchorages on the east coast of the Celebes ; new plans :—Una Una road, Togian bay, Pagimana road.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.—No. 109—England, east coast :—entrance to the River Humber. 2184—Ireland, south-west coast, including Crookhaven. 1804—France :—Cape St. Sebastian to Cette. 2755—United States, east coast :—Long island sound, sheet II. 761—West Indies, India islands, and Carribean sea, sheet I. 762—West Indies, India islands, and Carribean sea, sheet II. 2088—Africa, south coast :—Umtavuna river to Tugela river. 2137—Gaspar strait. 2636—Strait of Makassar, north part. 1261—Cochin China :—Saigon river to Kam ranh bay. 1459—China, south coast :—Hong Kong harbour. 2409—West coast of Formosa and Pescadores channel. 809—Tasmania :—Frederick Henry and Norfolk bays. 2766—North-east coast of New Guinea. 764—South-west Pacific :—New Hanover, New Ireland, and New Britain. 2532—New Zealand, sheet IX :—Banks peninsula to Otago.

May.—New Charts.—3638—France, south coast : Golfe de Fréjus and Rade d'Agay. 2487—United States, east coast :—Portsmouth harbour. 3659—South America; Ports in Magellan strait :—Canal Condor and Lago de la Botella, Puerto Condor, Puerto Toro, Port Valderrama, Puerto Pomar. 3651—Chile; Plans in the Guaitecas islands.—Port Barrientos, Port Low, Port Melinka. 3626—Borneo :—Dumpil point to Gaya head including Gaya island. 3616—Celebes :—Tomori gulf to Salayar strait including Buton strait and gulf of Boni. 1968—China, east coast :—Formosa island and strait. 1258—Korea, west coast :—Approaches to Seoul, including Techong (Sir James Hall) group. 1969—Japan :—Ozuchi jima to Funoko sima. Plans :—Uno wan. Takamatsu ko. 3629—New Zealand :—Hokitika to Otago harbour including Cook strait. New Plans and Plans added.—2116—Denmark; Little Belt. Plans added :—Aarhus harbour; Svendborg harbour. 158—Italy, chart II.; Cape Cavallo to Civita Vecchia and adjacent islands. Plan added :—Talamone bay. 930—Plans of anchorages between Borneo and New Guinea. New plan :—Wahai and Hatiling bay. 3340—Gulf of Tartary, northern sheet. Plan added : Angevo road. 384—Plans in Tasmania. Plan added :—East bay and Blackman bay. 55—Anchorages in New Britain, New Ireland, and New Guinea. New plan :—Byron strait to Nusa harbour.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.—1150—England, east coast, river Thames :—Erith to Broadness. 3466—Germany :—Wilhelmshaven. 3261—Germany, Elbe river :—Outer light vessel to Brunsbuttelkoog. 3262—Germany, Elbe river :—Brunsbuttelkoog to Hamburg. 696—Germany :—Kiel harbour. 185—Germany :—Port Swinemünde and approaches to Stettin. 284—Newfoundland :—Cow head harbour to Ste. Geneviève bay. 2843a—United States, east coast :—Chesapeake bay, sheet I. 192—Gulf of Mexico :—Galveston entrance. 40—India, west coast :—Karachi harbour. 2160—Carimata strait. 1342—Cochin China :—Fan-rang bay to Tongking gulf. 775—Cochin China :—Approaches to Haifong. 1741—Canton river, sheet II.

These charts are issued by Mr. J. D. Potter, 145, Minories.

ARTS AND CRAFTS.

Fashion in Pottery.—We talk of the freaks of fashion, but just lately fashion has been pursuing a course which is fairly consistent if not strictly straight. Not so very many years ago the demand was all for things in the manner of the later Louises and of the French Empire—to-day it is English styles of about the same period which are the rage, and the French styles have given place to patterns of the Georgian and early Victorian, and even the mid-Victorian period.

There must be to-day many a housewife and paterfamilias mourning over the disappearance of the furniture of their early married days which was turned out some time back to make room for what was then the latest thing in the way of house adornment—and many a rashly energetic daughter of the house who laments the haste with which, only a few years ago, she abolished the ormolu ornaments, got rid of the "old-fashioned" furniture, and relegated the china of an early period to the nursery and the school-room so effectually that but little remains to tell the tale. Marked as this movement has been in all directions—in designs for wall-paper, cretonne, carpets and furniture to mention only a few instances—it is perhaps peculiarly noticeable in china and pottery. Imitations and reproductions of old continental patterns are, of course, still being made and sold in fair quantities, but the market for revivals of English makes of a century or more ago has enormously increased. For the moment, perhaps, one of the most conspicuous crazes is in favour of reproductions of what is known as "powder blue," but old patterns of all kinds are being rapidly imitated and sold in large quantities. Of course, Chelsea and Bow and Leeds ware are in keeping with the prevailing style of decoration, and that probably has more than a little to do with their popularity. It is more important to the casual buyer that he should be able to say that his latest vases are designed after a style in harmony with the furniture of his room than that they are intrinsically beautiful or even valuable. Thus the great proportion of china and earthenware being turned out and sold in the ordinary shops to-day is not merely on strictly traditional lines, but is for the great part an imitation, and mostly a deliberate copy of work done about a century and a-half ago. This is all the more extraordinary in view of the experiments, and the consequent advances, made in pottery production both at home and abroad.

Modern Pottery.—There has been an opportunity during the last month of seeing very different directions in which pottery manufacture—or rather the production of ornamental pottery—runs when it gets somewhat away from the beaten track. On the one hand, Mr. A. H. Powell has been exhibiting the hand-painted pottery which he has executed for Messrs. Wedgwood, and on the other a larger and more perfect collection of Lancastrian lustre ware than any hitherto shown has been on view in London. It would be difficult to imagine two more different treatments of the same type of material. Indeed, the treatment is so fundamentally different that we are almost tempted to forget that the material is the same. Mr. Powell has not, as some of his critics seem to imagine, revived a lost art by painting on china and earthenware, whether over or under the glaze. The art of painting by hand on china never died out—partly because there has always been a steady demand for a kind of rather elaborately painted work, and partly because for some less pretentious purposes hand-painting is not only better, but actually cheaper than printing would be. He has, however, relied on primitive methods of work, and in many, if not most of his pieces, deliberately sought simplicity. And there is, of course, nothing stereotyped or mechanical about his work, nor does he, though he founds himself at times upon old patterns of various types, hark back to any particular period of design. The main interest of his productions lies in the fact that they are the artist's efforts to express himself, and not an attempt to conform to any particular set of conventions.

The Lancastrian lustre ware is essentially different. It owes its existence to careful and intelligent scientific experiment. Mr. Burton, far from relying on old or rule of thumb methods, has, as those who heard his lectures know, used all the resources of modern knowledge—and used them to produce something which, while in one sense it rivals Persian and Hispano-Moresque work, is in another pre-eminently modern. Of course, in a process like lustre painting the action of the fire counts for much—painting which has to be fired naturally runs the risk of being unexpectedly changed in the oven. No two pieces of such work are exactly alike, nor would they be so even if the designs on them had been printed instead of painted—the fire takes care of that. Yet, for all that, the perfection of the chemical process is shown by the even distribution of the lustre, and the number of pieces in which the effect obtained is quite evidently that which was sought. The designs are for the most part the work of artists employed at the works, and are painted by them straight on to the pots, and these bear the mark of the painter on the base; but there are a few large pots, and those not amongst the least successful, which are decorated after designs by Mr. Walter Crane. It is not always, however, the most elaborately painted pieces which are most pleasing in effect, and it may be said that the broadest designs always work out best.

From hand-painted dinner ware and such like to painted lustre is indeed a far cry, and the two classes of work are too widely apart to admit of direct comparison; for all that, it is impossible to study them both without reflecting that, admirably suited to certain purposes as primitive simplicity may be, there is everthing to be gained by making the most of modern knowledge of all kinds, scientific and mechanical as well as artistic.

Silversmiths' Work.—There has been good and serious silversmiths' work to be seen in London

during the last few weeks. The Artificers' Guild have been holding a special show, which includes, as well as some interesting jewellery by Mr. Bonner and by other workers attached to the guild, another version of Mr. Spencer's Altar cross, and some satisfactory though very simple chalices the workmanship of which, as was to be expected of the guild, is all that could be desired. However, the most important event of the month in this direction is the completion of the large monstrance for the Westminster Cathedral on which Messrs. Omar Ramsden and Alwyn Carr have been working for the last two years. Some parts of the design were on view with the artists' other work in November, but it is only within the last couple of weeks that it has been possible to see the completed work. One is apt to look upon a monstrance as being of necessity a peculiarly ugly piece of church plate. That may be because there are so many of late period and florid design to be seen in cathedral treasuries all over the continent—but it is partly because, from an artistic point of view, the central glass disc is bound to be a sort of anti-climax. Of course, in this monstrance, too, the central disc is of necessity the point to which the surrounding ornament leads up—but there is here nothing florid in design at all. The main outline is cruciform, with small plaques of translucent enamel at the four ends, representing on the one side scenes from New Testament history in strikingly brilliant colours, on the reverse the symbols of the four evangelists in more sombre blues and greens. The ornament surrounding the centre conforms to a square placed so that its corners fall between the four ends of the outer cross. That on one side is a treatment of the vine, that on the other of the wheat ear, in both cases simple and restrained though the somewhat stiff ear of wheat, however appropriate symbolically, is less easily turned to artistic account than the vine. This centre is further surrounded by some strictly conventional clouds—quite flat in treatment—which are as unlike the billowy structures on an ordinary monstrance as the slender rays terminating in amethysts and crystals are unlike the habitual rather wriggling ones. The fact that the monstrance will be carried in procession has had to be taken into account in its fashioning, and the making of so large a piece of plate in a way which shall render it both substantial and light was no easy task. It has, however, been successfully accomplished and the result is a piece of silversmithing worthy both in design and workmanship of the cathedral which it is to adorn.

GENERAL NOTES.

TRADE WITH GREECE.—Reporting upon the trade of the Piraeus and district (Cd. 3283) Mr. Consul Errol McDonall directs the attention of British manufacturers to the desirability of appointing local agents. It is very dangerous, the Consul says, to attempt business without one, but it is more dangerous to appoint one without using the utmost caution. Many cases are known of firms attempting direct trade, and the results have invariably proved, in the long run, disastrous. A local agent who is energetic, and has a thorough knowledge of prevailing conditions, is a valuable and indeed indispensable adjunct to successful trading with Greece. Firms who are well represented have few losses to report, and, as a rule, are well satisfied with the business done on the market.

GRAPHITE DEPOSIT.—The *Queenslander* (Brisbane), in pointing out that the demand for graphite is at present greater than can be supplied, and that adulterated materials are coming into use, calls attention to the existence of an extensive deposit of this valuable material four miles from Netherby railway station, on the North Coast line, Queensland, with a railage of only 30 miles to the port of Maryborough. This deposit, it states, holds out every inducement for an extensive and profitable manufacturing industry being opened up in Australia, as hitherto the production of clean graphite in that country has been unknown, although the mineral has been looked for in many places. The Queensland graphite plumbago mine was opened up three years ago. The development of the mine is extensive, showing a good body of the material about 30 feet thick, with bands of other material through it. The great difficulty was to cut a road down the mountain, which has been done. The material has been shipped to various parts of the world, and is said to have given great satisfaction for all uses.—*Board of Trade Journal.*

THE TRADE OF RÉUNION.—1906 was a trying year for Réunion. The prices of its products was very low, and in the case of sugar, the staple product of the island, below the cost of production. The communes are deeply in debt and unable to pay their functionaries. The local Government owes some 600,000 francs, and was only able to pay the salaries of the colonial functionaries in December by means of an advance from the central Government. A loan of 2,000,000 francs has been applied for in France, and will be granted on certain conditions, but it seems doubtful if the amount will be sufficient to pay outstanding debts, and to set the colony on its feet. This state of things is largely due, as Mr. Consul Maxse points out (Cd. 3283), to the fall in the price of sugar. The year was a very good one as regards quality and quantity, but a very bad one as regards the prices obtained. The average difference between the cost of production and the market price, Mr. Maxse says, is from 10 to 15 per cent. against the planters, Up to the date of the report only about three-fifths of the 1906 crop had been sold. The great fall in the rate of exchange has also hit the planters very hard.

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FRIDAY, JULY 12, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

APPLIED ART SECTION COMMITTEE.

A meeting of the Committee of the Applied Art Section was held on Thursday afternoon, 4th inst. Present: Lewis Foreman Day, F.S.A. (in the chair), Cyril Davenport, F.S.A., A. Lasenby Liberty, Alexander Siemens, R. Phené Spiers, F.S.A., Hugh Stannus, F.R.I.B.A., Carmichael Thomas, Sir Thomas Wardle, with Henry B. Wheatley (Secretary of the Section).

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Monday afternoon, the 8th inst. Present: Sir William Lee-Warner, K.C.S.I. (in the chair), Thomas Jewell Bennett, C.I.E., Sir Frederic W. C. Fryer, K.C.S.I., Alexander Rogers, Thomas H. Thornton, C.S.I., D.C.L., Sir Raymond West, K.C.I.E., M.A., LL.D., Arthur N. Wollaston, C.I.E., Lieut.-Col. Sir William Curzon Wyllie, C.V.O., K.C.I.E., Colonel Charles S. Yate, C.S.I., C.M.G., with S. Digby, C.I.E. (Secretary of the Section), and H. B. Wheatley, Assistant Secretary of the Society.

MULREADY PRIZE.

The Council of the Society of Arts are prepared to offer, under the terms of the Mulready Trust, a Gold Medal, or a prize of £20, for competition amongst students of the Schools of Art of the United Kingdom, at the Annual National Competition to be held in 1908.

The prize is offered to the student who obtains the highest awards in the following subjects:—

(*a*.) A finished drawing of imperial size from the nude living model.

(*b*.) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses (mounted on not more than two imperial size mounts).

(*c*.) A set of studies of hands and feet from the living model (mounted on not more than two imperial size mounts).

(*d*.) Drawing from the life, including memory life drawing done at the Examination in May, 1908.

No student will be eligible for the award who does not pass in the Examination (*d*) in drawing from the life, and who does not obtain an award for (*a*) the finished drawing of imperial size from the nude living model. The other two subjects are optional.

The works must have been executed between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1892, 1893, 1896, or 1903, cannot compete again.

The drawings, &c., are to be submitted, with other school works, in the usual manner to the Board of Education, South Kensington, in April, 1908. Each competing drawing must be marked "In Competition for the Mulready Prize," *in addition* to being labelled according to the Regulations of the Board of Education.

CONVERSAZIONE.

The Society's Annual Conversazione in the gardens of the Royal Botanic Society, Inner Circle, Regent's-park, took place on Tuesday evening, 9th inst.

The reception was held by Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman,

and the following members of the Council, Sir William Crookes, D.Sc., F.R.S., the Hon. Sir Charles Fremantle, K.C.B., Mr. Robert Kaye Gray, Sir Charles Augustus Hartley, K.C.M.G., Sir John Cameron Lamb, C.B., C.M.G., the Hon. Richard Clere Parsons, M.A., Mr. Carmichael Thomas, and Professor John Millar Thomson, LL.D., F.R.S.

The gardens were illuminated by coloured lanterns and also by "Kitson" incandescent oil lamps. The Corridor and the Victoria House were lighted by "Blanchard" incandescent oil lamps.

A selection of music was performed by the string band of the Royal Marine Light Infantry (Portsmouth Division), conductor, Lieut. George Miller, M.V.O., Mus.Bac. Cantab, in the Conservatory, and by the band of H.M. Coldstream Guards, in the Corridor.

An exhibition of growing and cut roses and other flowers was arranged in a marquee in the grounds by Messrs. W. Paul and Sons, of Waltham Cross, and an exhibition of rhododendrons and foliage plants was also arranged in the Corridor by Messrs. John Waterer and Sons, of Bagshot, Surrey.

The Victoria House, containing the giant water lily (*Victoria Regia*), and a collection of economic and other interesting tropical plants, was open to visitors.

A "Watteau" Pastoral Play in three acts, entitled "La Marquise," was performed in the Gardens by Mr. Patrick Kirwan's Idyllic Players.

A Concert and Entertainment, under the direction of Mr. Patrick Kirwan, was given in the Club-house.

The number of visitors attending the Conversazione was 1,363.

EXAMINATIONS.

The following is the Time Table for 1908 :—

	Monday, April 6. (7—10 p.m.)	Tuesday, April 7. (7—10 p.m.)	Wednesday, April 8. (7—10 p.m.)	Thursday, April 9. (7—10 p.m.)	Friday, April 10. (7—10 p.m.)
Advanced Stage.	Book-keeping. English. Economics. Danish and Norwegian.	Arithmetic. Commercial Law. German. Italian. Spanish.	French. Commercial History and Geography. Typewriting (7.30 to 10 p.m.).	Accounting and Banking. Shorthand (140 and 120 words per minute) (7.15 to 10 p.m.).	Portuguese. Précis-writing. Russian. Swedish. Chinese. Japanese. Hindustani.
Intermediate Stage.	Typewriting (7.30 to 10 p.m.). French. Danish and Norwegian. Commercial History and Geography.	Book-keeping. Précis-writing.	English. Economics. Spanish.	Arithmetic. German. Portuguese. Italian. Russian. Chinese. Japanese. Hindustani.	Swedish. Shorthand (100 and 80 words per minute) (7.15 to 10 p.m.).
Elementary Stage.	Handwriting and Correspondence. French.	German. Italian. Typewriting (7.30 to 10 p.m.).	Book-keeping Spanish.	Shorthand (50 words per minute (7.15 to 10 p.m.).	Commercial Geography. Arithmetic.
Music.		Harmony.	Rudiments of Music (7 to 9 p.m.).		

The last day for receiving entries is March 3.

The special subject for Commercial History and Geography is :—The Dominion of Canada together with Newfoundland.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

Tuesday, May 28th, 8 p.m. SIR JOHN EDWARD BINGHAM, Bart., in the chair.

The paper read was—

SHEFFIELD PLATE AND ELECTRO-PLATE.

By SHERARD COWPER-COLES.

Necessity—thou best of peace makers,
As well as surest prompter of invention.—*Scott.*

Sheffield Plate.—Introduction—Mercurial or fire-gilding—Pyro plating—Close plating—Historical sketch—Method of making the ingot—Rolling the ingot—Tests for old Sheffield plate—Various examples of old Sheffield Plate.

Electro-Plate.—Historical sketch—Processes employed in the making up of Electro-plating—Preparation of the surface to be deposited on—Depositing the silver—Finishing the silver surface—Burnishing—Colouring—Sand blasting—Frosting—Doctoring or ragging—Bright silver-plating—Differential or localised electro-plating — Stripping and dipping—General arrangement of an Electro-plating shop—Electro-deposition of silver alloys—Conclusion.

INTRODUCTION.

Before Sheffield plate, or, more strictly speaking, Sheffield plated ware, was introduced, mercurial, water or fire gilding was much in vogue, and for many centuries was exclusively used for coating copper and brass ecclesiastical plate, chalices, and similar objects. The process consists of brushing over the surface of silver, copper, brass, or bronze alloys with an amalgam of gold and quicksilver and afterwards volatilising the mercury by heat. By repeated application of the amalgam and heating, thick deposits of metal can be obtained. The process of necessity is confined to those metals which combine with mercury to form an amalgam. Damascening has also been employed for gilding surfaces of some dimensions with gold or silver, by forming around the portions to be covered an undercut line or incision.

Pyro plating is closely allied to Sheffield plating. The process consists of burning the more precious metal into the surface to be coated, as its name implies. The coated metal is subjected to heat in a muffle, or other suitable furnace, and when hot, plunged into cold water, the force of contraction causing the coating of silver to penetrate into the pores of the underlying metal, the two metals becoming inseparable by mechanical means. So thoroughly will the silver penetrate the underlying metal that minute portions of silver may be found retained in its pores after laying bare the base metal by grinding. This process, however, is little used, the thickness of the coating obtainable being limited, while the degree of heat required is not less than 450° Fahr., thus prohibiting its application in a large number of instances. Pyro plating is principally adapted to iron and steel goods, which require careful cleansing to ensure the removal from the pores of the iron of all foreign matter, which otherwise would volatilise when the iron came to be heated, causing the deposit to blister, and form a rough unsightly surface.

The method usually employed for preparing iron to be pyro plated is as follows:—All grease is removed by boiling in caustic potash, after which the article to be plated is well scoured with emery and water and steel brushes. It is then made the cathode in a hot alkali solution, and a strong current caused to flow so as to evolve abundance of hydrogen. As soon as the iron or steel assumes a silver appearance, it is quickly removed into the electro-plating vat. Alloys may be formed by the pyro process by electro-depositing a thin coating of one metal upon another, for instance, zinc on copper, and then burning in.

Close plating is another step towards Sheffield plating, and has been carried on in this country for about 200 years, and is used for coating harness and carriage fittings, not that it affords any special advantage, as the process is expensive and troublesome, but principally on account of the prejudice and conservatism of the coachbuilding trade. Close plating consists in coating the iron or steel articles with a thin sheet of standard silver, brass, or other metal, which is secured to the iron by previously tinning it (often called sweating), and then passing a hot soldering iron over the sheet covering metal, the surface being finally brightened by polishing or burnishing by the usual methods.

SHEFFIELD PLATE.

Historical Sketch.—It was in the year 1838 that electro-plating was introduced, which rapidly superseded Sheffield plating, and it is only within the last ten years that Sheffield plate has been largely sought after by collectors.

In the year 1742 Thomas Bolsover, a mechanic, experimented on the uniting of silver and copper, having accidentally fused the two metals whilst repairing the handle of a knife,

which was composed partly of silver and partly of copper. He observed that a coating of silver could readily be applied to copper by bringing the latter metal into contact with molten silver, and that such a process could be adapted to the manufacture of copper sheets which could be fashioned into articles such as snuff boxes, that hitherto had been wrought in solid silver. Joseph Hancock became acquainted with the Bolsover process, and realising its importance, he started a workshop in Sheffield, where he employed the combined metals for producing a variety of articles which had hitherto been made entirely in silver. The process was rapidly brought to perfection, and quickly grew into a large industry in the towns of Sheffield, Birmingham, London and Nottingham.

Method of Making the Ingot.—The process as evolved from the work of Bolsover consists in plating a bar or ingot of copper, from about 1 in. to 1½ in. in thickness, the breadth and length varying according to the size of the sheets required. The bar of copper is well filed, scraped or planed, so as to obtain a surface free from all flaws. A sheet of silver of varying thickness from one-sixth to one-eighth of an inch or more, of the same size as the copper ingot, is likewise prepared, and the two clean surfaces are brought in contact by placing an iron plate about one-quarter of an inch thick and of approximately the same size as the ingot on the silver sheet, the whole being tightly bound together by twisted iron wire. A solution of borax is applied to the edges of the silver; the whole is then heated in a muffle furnace until the silver is just on the point of fusion, when it is quickly removed and allowed to cool. When it is desired to produce a copper sheet covered with silver on both sides, the operation is exactly the same, with the exception that a silver sheet is placed on each side of the ingot, instead of one side only.

Rolling down the Ingot.—The ingot when cool, is freed from scale and oxide by pickling in sulphuric acid and scouring with sand, and is then ready to be rolled down into a sheet of the desired thickness, being annealed from time to time as it becomes too hard for further treatment.

When rolling down the sheet of copper and silver, it occasionally happens that blisters form on the surface, due to imperfect adhesion between the silver and the copper. If the portions which have become blistered cannot be removed when cutting the sheet up into the shapes suitable for the articles to be fashioned, these blisters are broken by pricking, to allow the escape of air; the blister is heated and the silver rubbed down by means of a steel burnisher. Should the blister have burst during the process of rolling the sheet when annealing, it becomes scaly, necessitating the removal of the blistered portion by scraping, and making good by thoroughly cleaning the copper surface, then applying silver leaf to the damaged portion, then heating and rubbing down with a steel burnisher.

In 1784 George Cadman, in partnership with Samuel Roberts, introduced an improvement by soldering on silver edges and mounts, thus protecting those portions most exposed to wear, and covering the unsightly copper edges. The edges or mounts were stamped in thin silver sheet and soft soldered to the Sheffield plate.

Tests for Sheffield Plate.—Modern Sheffield plate made by electro-depositing silver on copper articles is usually readily detected by the thinness of the silver coating as compared with old Sheffield plating, and by a solid silver piece in the centre of the articles, on which the crest or coat of arms was engraved. Another sure indication of Sheffield plate is bands of narrow strips of silver wrapped round the edges and the mounts such as handles and feet, made of silver stampings, and the backs of trays and similar articles being coated with tin, which was done by heating the articles to the melting point of tin, and then wiping the tin over the surface, using a suitable flux, such as zinc chloride. No tin backs or tinned linings are found on modern Sheffield plate. Another distinguishing feature is that soft solder was always employed in making up Sheffield plate, and the mounts also filled with soft solder. A rough or unfinished edge will occasionally afford evidence as to the genuiness of a piece of Sheffield plate.

The only use to which Sheffield plate is put at the present time, is to the manufacture of Reflectors, the rolled bimetallic sheets being cut into circles and then spun or stamped into the desired form.

Marks on Sheffield Plate.—Most of the marks found on Sheffield plate are to be found in Caldicott and Redman's books dealing with Sheffield plate; several of the same marks are found on electro-plate, as some of the former manufacturers of Sheffield plate took up the manufacture of electro-plate. (Fig. 1).

I will now show you some lantern slides illustrative of the various sets of old Sheffield plate.

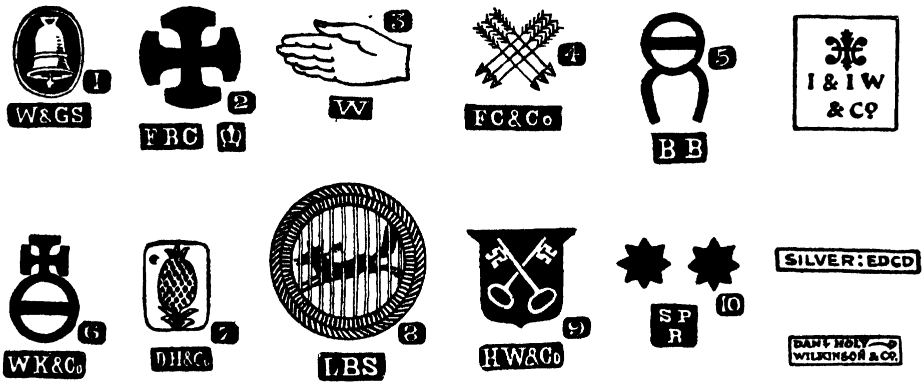
The first is an old Sheffield plate supper or breakfast set on a hot water tray with a gadrooned border. The next slide shows various samples of Sheffield plate, decanter stands, coaster and decanter wagons; the prices realised per pair varies from 35s. to 80s.

The next specimen is an elaborately wrought tray with a crest in the centre, engraved with a coat-of-arms on a silver plate which has became usual when snuffer trays became obsolete towards the middle of last century, to convert them into inkstands. Figs. 2, 3, 4, 5 and 6 show other specimens of Sheffield plate.

ELECTRO-PLATING.

In 1838 Messrs. G. R. and H. Elkington coated military and other metallic

FIG. 1.

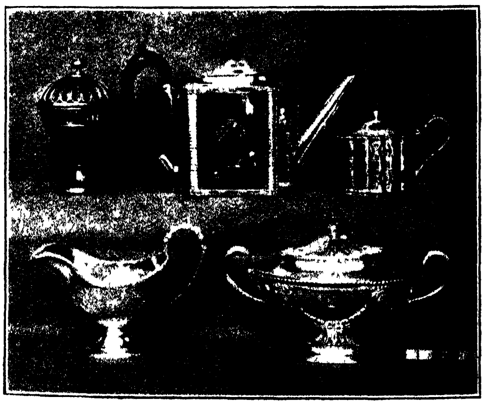


MARKS ON SHEFFIELD PLATE.

been let into the centre of the tray. The centre of this tray is probably not Sheffield plate, but close plating, which has been described, as it would be difficult, or almost impossible, to chase a piece of Sheffield plate so deeply without making the silver coating very thin in places.

The next lantern slide shows a beautiful

FIG. 2.



Sheffield plate wine cooler, with two handles and vine leaf decoration, height about 14 inches. Mr. Caldicott estimates that such a cooler would realise £25 if put up for auction.

The next illustration is a Sheffield plate inkstand, which would realise about £4 each. It

ornaments with silver and gold by immersing them in solutions of those metals. Alexander Parkes at the same time was experimenting for them, with a view of getting thick coherent deposits of gold and silver, the same as had already been obtained with copper by Jacobi, Jordan, and Spencer.

FIG. 3.

Still little progress was made until John Wright, a surgeon, discovered that by the use of cyanide of potassium, thick electro-deposits of silver could be obtained. Cyanides in several forms had been used, about sixteen months before, both for silvering and copper-

ing, by simple immersion, but Parkes was the first to deposit silver by the single cell from the double salt of cyanide of potassium and silver. The first article that received the

FIG. 4.

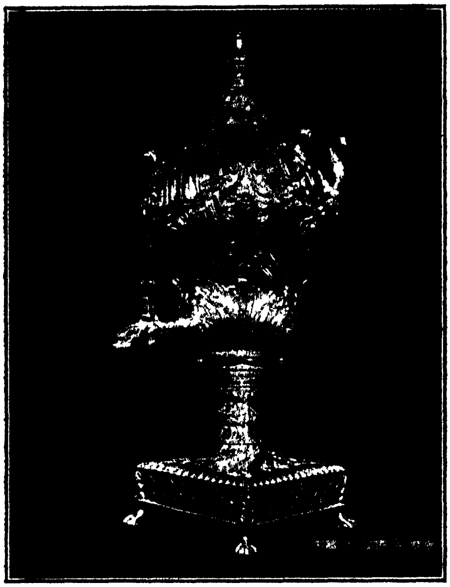
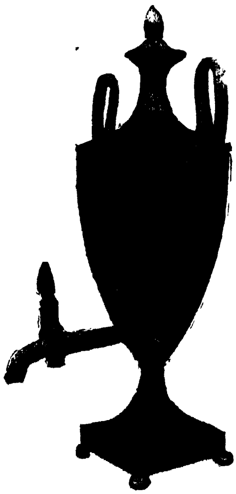


FIG. 5.



successful coating was a small vase at Wright's residence. The method employed was as follows :—

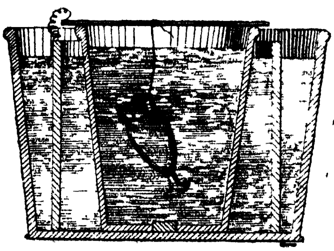
An ordinary garden flower-pot was used as a porous cell, and contained the silver solution; this was arranged in a larger vessel, filled with dilute sulphuric acid. The vase to be coated was placed in the silver solution, and connected by a wire with a sheet of zinc surrounding the porous cell, and immersed in the dilute acid, as shown in Fig. 7.

Wright having submitted his results to Messrs. Elkington, they were embodied by them in a patent, dated March, 1840, and a royalty of one shilling per ounce of silver

FIG. 6.

deposited was paid. This patent proved to be the basis of successful silver plating. After having rendered much valuable assistance in the perfecting of details so essential to the commercial success of any process, Parkes ultimately severed his connection with Messrs. Elkington, and died in 1891, having received a large sum from that firm in recognition of his services.

FIG. 7.



WRIGHT'S EXPERIMENT.

Success had now been attained as far as regards the obtaining of a regular thick deposit of silver, but there still remained various smaller difficulties to be overcome, in consequence of which electro-platers had a hard battle to fight, and it was not until some years afterwards that their trade became remunerative. Want of adhesion between the underlying metal and the silver, which would often peel off, or rise in blisters, under the pressure of the finishing tool, was one of the greatest difficulties which had to be overcome,

and in consequence great opposition was experienced, not only from the manufacturers of Sheffield plate, but from those who retailed their goods.

Imperfect cleansing and want of proper regulation of the electric current had a great deal to do with many of these failures, but the difficulty was not really overcome until Leeson demonstrated that by immersing the articles in an aqueous solution of mercury, and allowing them to receive a very thin film of that metal by chemical exchange before putting them in the plating vat, perfect adhesion could be ensured. The articles thus enfilmed with one of the nobler metals are not easily oxidized, and retain an unaltered surface when exposed to the atmosphere for a period that would suffice to produce a film of oxide on copper, zinc, or their alloys, and thus prevent adhesion. This amalgamating, or "quicking" process as it is called, is only applicable to copper and its alloys. Iron and steel having no affinity for mercury, another method had to be devised for making the silver coating adhere to those metals. It was found that by first electro-depositing in an alkali bath, a thin coating of copper on the iron or steel, and then quicking, the desired end could be obtained.

Of no little importance to the success of the silver-plating industry was the introduction of the dynamo. Even when the single cell method, in which articles to be coated were simply made one of the poles of a battery, had been given up, the only reliable source of current was from primary batteries, which required much attention, and entailed a great expense from the large consumption of zinc. It was not until 1863 that the dynamo made its appearance as a substitute for batteries. One of the earliest machines was that of Wilde, separately excited by a small magneto machine. Not very long after the principle of self-excitation was evolved, Wiener Siemens suggested the series dynamo, and Wheatstone the shunt dynamo.

The extent of the electro-silver plating trade about the year 1880 can be gathered from the following extract from Fontaine's book on "Electrolysis," at which time the majority of the controlling patents had lapsed for twenty years so the number of manufacturers had naturally been increasing but not to any considerable extent, as the important capital required by the high value of the metal has been a bar to many would-be manufacturers. There were not more than ten factories in Paris at that time where the silver plating business was conducted on a really industrial footing. Fontaine states that "The small installations do not succeed, encumbered as they were with general expenditure which prevents them advantageously competing with more powerful and better organised firms."

One single silver-plating establishment in Paris, according to Bouilhet, that of Messrs. Cristofle and Co., annually deposited at that time more than 600 kilogrammes of silver, and since the date of its foundation in 1842, it has used not less than 169,000 kilogrammes of silver deposited upon an incalculable number of objects. The average thickness of the deposits is that which corresponds to 3 grammes per square decimetre, or 300 grammes per square metre, so that the area this factory alone has covered with silver is not less than 563,000 square metres, over 56 hectares (140 acres).

Bouilhet estimated from certain authentic information which he had been enabled to gather that 25 tons was the yearly quantity of silver used in Paris alone for silver-plating purposes, and that if we estimate the producing powers of other countries, which are well known, and compare them with France, he computed the quantity of silver annually deposited by electrolysis in Europe and America at 125,000 kilogrammes (125 tons) which represents an intrinsic value of over 25 millions of francs (£1,000,000 sterling).

The weight of silver deposited at Sheffield alone, in the year 1883, was 300,000 ounces, in round numbers some 8¼ tons. Taking the price of silver at 4s. per ounce its value amounts to upwards of £60,000. If we imagine all this silver deposited at the weight of one ounce per square foot the total surface that it would cover would be nearly seven acres.

The business of replating must always be a growing trade, considering the vast quantity of plated goods which actually flow into the market, and which must, even the best of it, require replating at some time or other.

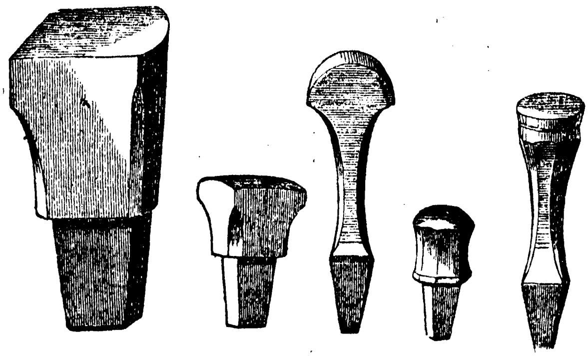
The export of plate, plated and gilt wares, from this country for the year ending 1906, amounted to about £600,000. Of the demand some idea may be formed, when it is remarked that it is the custom with many hotels constantly to employ some four or five hands cleaning over 5,000 spoons and forks daily. It is computed that there are about 170 electro-platers in Sheffield and over 100 in Birmingham.

Hall Marking Electro-Silver Plate.—Hall-marking in Great Britain is confined to a standard silver, but the French and German Governments stamp all electro-silver plate as a guarantee of the actual weight of silver deposited, so that the public may know exactly what they are buying. This precaution, though commendable, must of necessity increase the cost of electro-silver-plated goods, and stifle individual enterprise. Now that the electro-deposition of a standard silver on a commercial scale is an accomplished fact, a careful system of analysis will have to be added to that of weighing, if any importance is to be attached to the Government stamp. The best way the difficulty can be met is, undoubtedly by responsible firms guaranteeing the weight and standard of silver deposited, and marking their goods accordingly.

Making up Electro-Plate.—Time will only permit of my referring very briefly to the principal processes of making up electro-plate from the flat sheet, which are similar to those formerly employed for making up Sheffield plate. The sheet, after it comes from the mill, is annealed and cut into the approximate shape of the article to be fashioned. It is then stamped, spun, or beaten into the desired form. Blanks for spoons are stamped into shape, the blow being given by means of a heavy weight containing half the die; the weight is raised by a belt working over a pulley; when tension is applied to the belt, the friction of the running pulley causes the weight to be raised to the desired height necessary to give the force of blow required.

Another method is to place the flat blank of metal in a lathe against a wood mould of the desired shape, the metal being held in position by means of a centre; a round nosed tool is brought to bear on the metal so as gradually to stretch it over the mould. The metal when it gets too hard is annealed and the process continued until the desired shape is obtained.

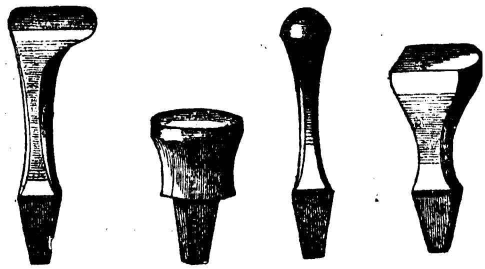
FIG. 8.



ANVIL. LONG HEAD. HALF MOON STAKE. ROUND HEAD. ROUND BOTTOM STAKE.

A third method is to fashion or shape the article by hammering or beating it on a block of hard wood or steel stakes, types of which are shown in Figs. 8 and 9.

FIG. 9.



TEA KETTLE BOTTOM STAKE. OVAL HEAD. PEPPER-BOX TOP HEAD. ANVIL STAKE.

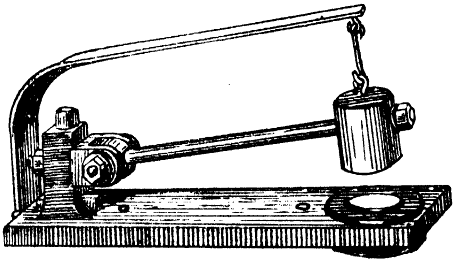
The process of flat hammering renders the surface perfectly smooth and level, and at the same time hardens the metal. Upright steel faced stakes are used embedded in large wood blocks, and the hammers are bright steel of a variety of shapes and weights.

In flat hammering the top side of the article is always kept next to the stake, and the

underneath side of the article kept uppermost whilst it is undergoing hammering, to prevent any hammer marks showing and any dirt which may settle being hammered into the upper surface. To ensure the centre of a tray being true and level it is laid on a large block of iron on which a piece of cloth is placed; the tray is then held firmly, and a tracing punch moved slowly over the surface, the punch being lightly hammered all the time.

Large surfaces are often planished by such an apparatus as shown in Fig. 10, which requires little skill to work as compared to using a planishing hammer.

FIG. 10.

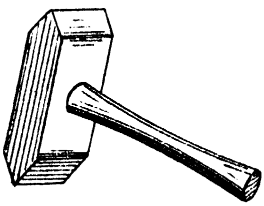


PLANISHING MACHINE.

FIG. 11.

LEATHER-FACED HAMMER FOR REMOVING BRUISES.

FIG. 12.



RAISING MALLET.

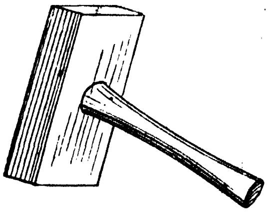
For the removal of bruises a leather-faced mallet is employed, Fig. 11.

Raisers or hammermen are those who raise or hammer from the sheet metal; mallets of different sizes and shapes are employed according to the size and shape of articles required, Figs. 12 and 13.

Hammers of different shapes and sizes are also employed, of which Fig. 14 is a type.

Curved work has the hammer marks removed by a hammer such as shown in Fig. 15, often used in conjunction with an elbow stake, Fig. 16, or by a mangling machine, Fig. 17, which, as its name implies, is designed to

FIG. 13.

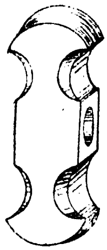


RAISING MALLET.

Fig. 14.

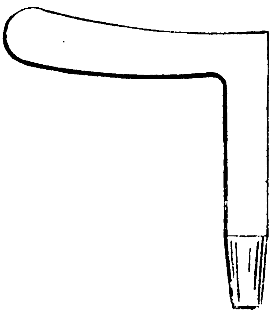
RAISING HAMMER.

FIG. 15.



PLANISHING HAMMER FOR CURVED WORK.

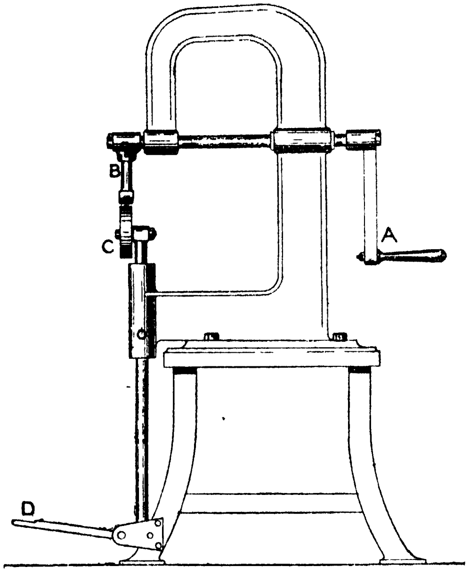
FIG. 16.



ELBOW STAKE.

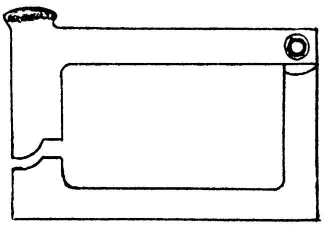
smooth out and remove creases and bruises A is an ordinary crank-handle keyed on the shaft, upon which the mangling-bed is also keyed; the handle does not revolve in a complete circle, but merely oscillates; the work is placed between the revolving disc, C, and the bed, B, while pressure is applied by the foot lever, D.

FIG. 17.



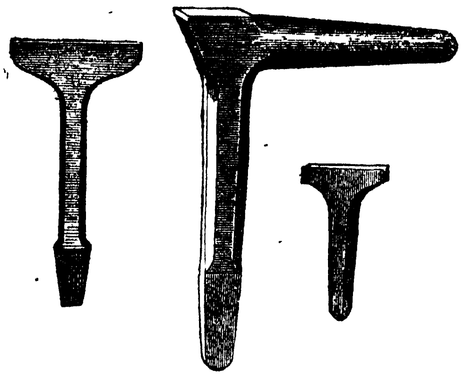
MANGLING MACHINF.

FIG. 18.



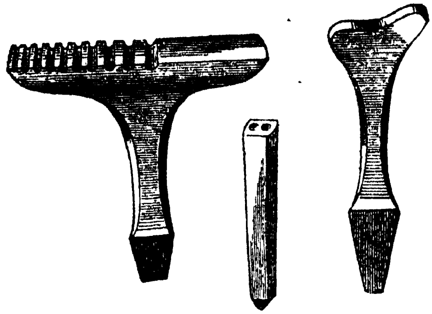
MOULDING SUAGF.

FIG. 19.



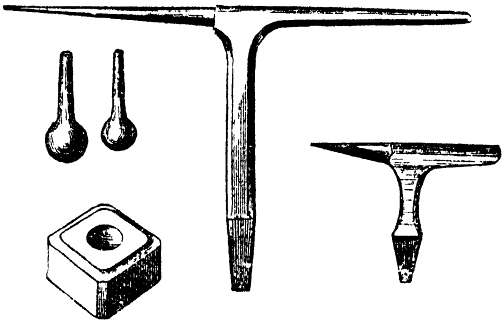
HATCHET STAKE. SIDE STAKE.

FIG. 20.



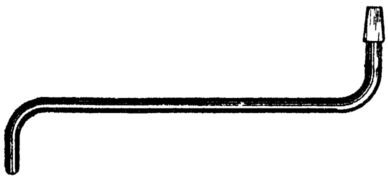
CREASING IRON. NECK TOOL.

FIG. 21.



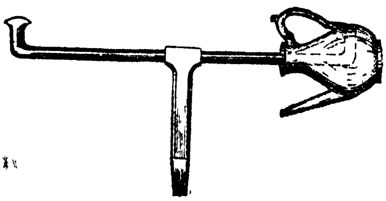
STUD BOX AND PUNCHES. NECK IRON. EXTINGUISHE STAKE.

FIG. 22.



SNARLING IRON.

FIG. 23.



SNARLING IRON.

To put a moulding round an article a suage is often employed, Fig. 18, which is held firmly in a vice and the edge of the article put in the jaws of the suage while it is hammered.

Figs. 19, 20, and 21 show some of the tools employed in making electro-plate and Sheffield plate, the names of which in most cases are a sufficient indication of the principal use to which they are put.

Fluted or chased work is done on pitch; the flutes are raised by the help of a snarling iron (Fig. 22 and 23), unless the fluting has been previously done in the process of stamping. The snarling iron is struck with a hammer near the point of support (Fig. 24), when the iron springs back it strikes the inside of the vessel thus reversing the metal. The article to be fluted is then filled with pitch and chased and is held in position by means of a stirrup, Fig. 25.

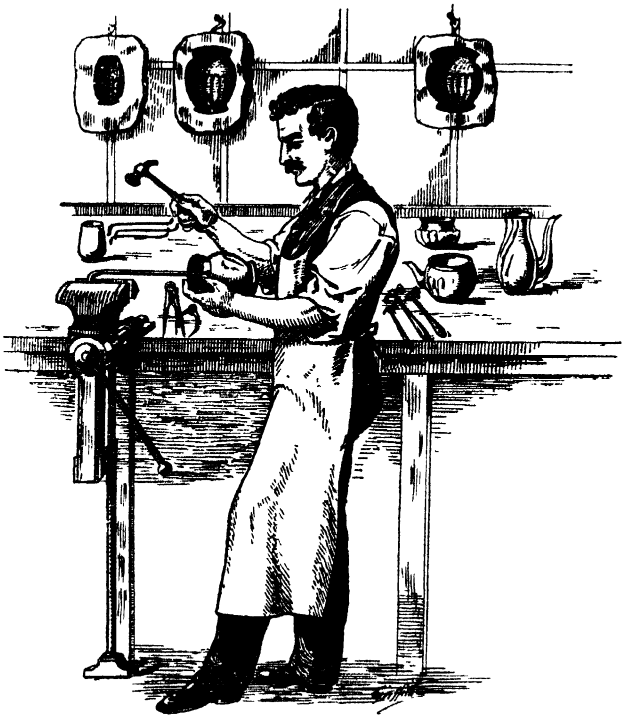
The form of shaving tool employed is shown on Fig. 26.

The engraving of an article is done after it has been made up and finished in every respect. A number of various shaped engraving tools are employed of which Fig. 27 is a type.

The engraving is done by pushing along the line to be cut by means of pressing the palm of the hand on the flat topped wood handle, the work being placed on a leather cushion filled with sand (Fig. 28), or a leather ring, Fig. 29.

The different portions of an article, such as a candlestick, after being stamped, fluted or chased, as already described, are then brazed together with hard or soft solder by means of a gas jet and air pressure.

FIG. 24.



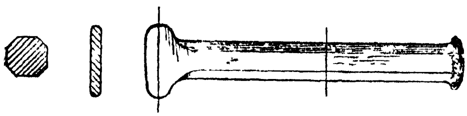
RAISING.

Brazing and Hard Soldering.—There are various methods of brazing and soldering, and dozens of different kinds of solder used. Hard soldering is nearly always done on a turn-table (Fig. 30, which represents a candlestick being hard soldered) on which are usually heaped small pieces of ordinary gas coke which have previously been well burned in a muffle to extract the sulphur. When a more level surface is required than the coke gives, a thick square fire brick or an iron plate is used. Coke is used as much as possible as it requires so little heat to make thoroughly hot, compared to either the fire brick or iron plate. The heat is obtained from gas, and air from a fan

FIG. 25.

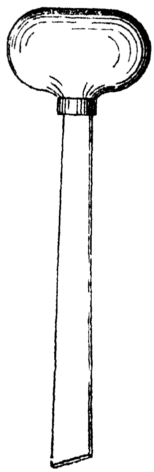
FLUTING.

FIG. 26.



SHAVING TOOL.

FIG. 27.



ENGRAVING TOOL.

worked by power, or from a pair of bellows worked with the foot.

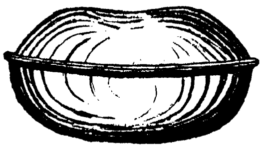
Other methods are adopted for soft soldering and very delicate work requiring hard soldering, mouth blow-pipes and soldering irons being employed. A blow-pipe with a round ball on is commonly used, as it retains a small supply of air whilst the blower takes his breath. Soldering irons are used for soft soldering, and are frequently used to solder and repair places where there is much soft solder near. If a blow-pipe were used, there would be a risk of the other soldered places springing.

For all classes of hard soldering, borax is used in combination with hard solder, and in a similar manner resin and spirits of salts are used for soft soldering. Borax is used either crushed, or finely screened, and mixed with water, or baked and crushed and screened and used dry. The advantage of baking is to prevent it from rising or blowing when the work is heated. Resin and spirits of salts are used differently. Resin is used in powder, and sprinkled on the work; it is also used in lumps to touch the soldering iron. Spirits of salts is also used for Britannia metal work, pewter, &c., and is always "killed" before using by adding spelter or bits of sheet zinc, until it ceases to bubble; a little sal ammoniac is sometimes mixed with it.

The solders used are many. Hard solder for silver is usually composed of—Silver, 1 ounce; brass, 10 dwts. A little arsenic is sometimes added to make it whiter, but this renders it less malleable. A very quick running solder for silver consists of—Silver, 1 ounce; tin, 1 ounce. Hard solders for all classes of nickel or German silver goods, commonly called "brass spelter," is composed of—Copper, 2 parts; zinc, 1 part. This is used either ground up in fine or coarse grains as required, or rolled into a sheet, then cut up into thin strips, or drawn into a wire, and cut up into small pieces for filling stamped handles, mounts, &c. There is also a harder solder employed com-called "white spelter." This requires a very much greater heat to melt, but it makes a very much harder seam afterwards. A solder extensively used and known as "brass spelter" is made of two parts brass to one part silver. To make richer or poorer it merely requires either more silver or brass adding. Solders for copper, iron, and brass, consist of different proportions of copper, brass, and zinc. The proportions depend on the particular kind of work which requires soldering.

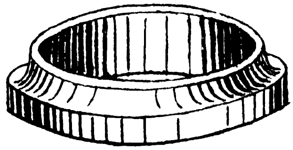
For soft solders, tin and lead only are used.

FIG. 28.



SAND CUSHION.

FIG. 29.



LEATHER RING.

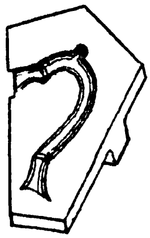
FIG. 30.

BRAZING AND SOLDERING.

For a good solder more tin, and for a poorer solder more lead is used. For a rich solder as much as 1 lb. tin to ½ lb. lead is used, but for a regular class of work more lead is usually employed.

Fig. 30 represents a man soldering a candlestick with a strip of hard solder (two parts brass to one part silver). It will be noticed that the pieces are fastened together with pieces of thin iron binding wire; this is to hold them in their required place whilst the soldering is completed. On the table will be seen two cans, one containing crushed borax, in which the workman dipped his strips of solder when hot, then, after holding the strips in the gas, and having made the article hot, on touching with the strips, still keeping the blast in the same place, the solder will immediately melt, and, if done in a proper manner, and not too much put on, will strike very cleanly, and require very little filling afterwards to make a good clean seam. On the bench at side of the lamp on same illustration will be noticed a teapot with the spout wired on ready for soldering. There is also a teapot body turned up waiting to have the seam soldered with either white or brass spelter, before it is finally shaped. Some round rings also lie on the bench ready to be laid on the brick to be soldered together to make cruet-ring parts. A cake basket is also shown

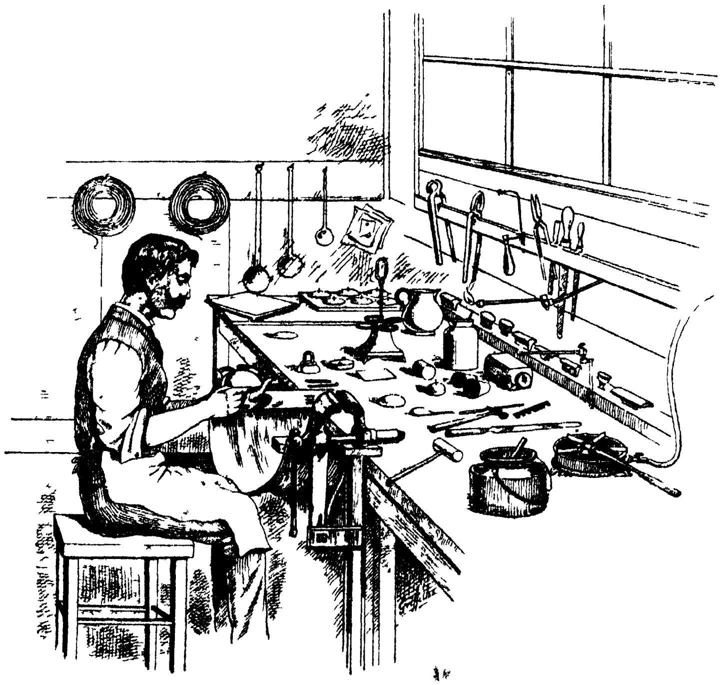
FIG. 31.



LEAD MOULD.

on the bench, with the foot bound firmly on, but not too tightly, awaiting soft soldering. If the binding wires were made too tight, the result would be that on the body getting hot the pressure would be so great that it would give way and sink a little. To move the articles whilst they are hot, several different

FIG. 32.



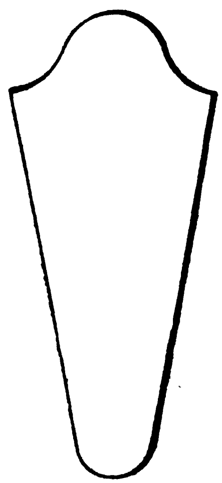
MOUNTING.

shapes of tongues are used; the principal two are the straight and the duck's-head shape. The duck's-head shaped tongs are used so that a good hold can be obtained, as when the work is still hot it is unwise to take hold too near the edge, as the metal is liable to break away. On the bench at the back of the lamp will be seen a teapot handle awaiting soldering. This is put together in two halves, which have been previously stamped and then filed level in a lead mould (Fig. 31). It first receives a thin coating of wet borax inside, and after a little brass spelter has been sprinkled on the borax, the two halves are bound together with binding wire, and heated until the soldier melts. If it does not strike and fill up the seam, a thin piece of iron wire, called a "tickler," is used, the end of which is made hot, dipped in the dry borax, then in a mixture of finely ground brass spelter and dry borax, and when melted the spelter and borax is dropped on to the spot which has been thoroughly heated at the same time ready to receive it. The borax is removed afterwards by "pickling" in a hot vitriol boil. Small things are placed in an earthenware vessel, large articles are suspended by brass wire. The spirit of salts, &c., is removed by cleansing in a caustic potash boil. A careful solderer saves hours of work in finishing which would otherwise be necessary if the work was carelessly brazed.

Mounters are the men who finish tea and coffee sets, entrée dishes, trays, waiters and other bodies, after they have left the hands of the raisers and hammermen. (Fig. 32.) Tea and coffee sets are made in several different ways, for instance the well-known Queen Anne patterns are built up from stampings; in the globe-shaped sets the bodies are raised and hammed as previously described. The handles are usually stamped and soldered together in two halves. In other cases "bodies" are spun on a spinning lathe, or stamping, spinning, raising and hammering are all brought into requisition. Scarcely any two shapes or designs are made identically in the same way. In many instances the work of making tea and coffee sets is divided; one man will raise the hammer, as previously described, and another will mount the pieces. In other cases the same man will both raise, hammer and mount. I will now proceed to give a description of how a teapot, for instance, is mounted.

The spout is turned up from a piece of sheet metal, as shown in Fig. 33, on a pipe stake. The handle is stamped in two halves, which are filed in lead moulds, as already described, so as to make both halves accurately meet; The halves are then soldered together: the domed cover is hammered from a piece of sheet metal on an upright head. The foot is either stamped or turned up from a moulding wire into a ring, to form a foot. After the spout, handle, cover and foot have thus been made, then comes the fitting of them to the body, and piece by piece they are soldered to the body. After the soldering has been done, then the article is pickled or boiled out in a solution of boiling vitriol, about 1 pint of sulphuric acid to a gallon of water, to remove all borax and dirt; they are then filled up, that is, all lumps of solder are filed off, all rough places filed smooth, and all rough edges left by the shears, &c., are finished off with the file. Fig. 32 represents a set mounter filing and finishing off a teapot. Entrée dishes are mounted somewhat differently, the mounts and handles are generally stamped; in some cases

Fig. 33.

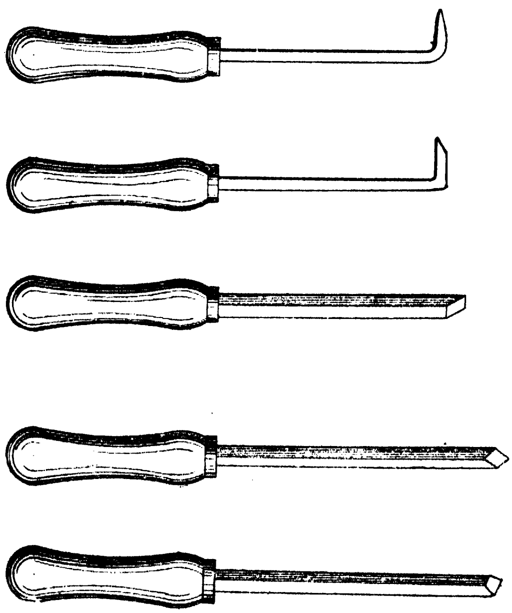


the mounts are turned up from solid wire of the pattern required. Mounts are stamped in different ways, sometimes in one piece; in the case of an oval entrée dish of a regular selling pattern the mounts are stamped in an oval shape. In the case of an uncommon pattern, to spare the expense of this, they are stamped in a straight strip and after they have been filled with brass for hard soldered dishes and soft solder in the case of soft soldered dishes they are bent to any desired shape. The

dish, body and cover are stamped or spun, and after they have been hammered as described elsewhere, they come to the mounter to be "mounted" or made up. After the mounts have been filled, and then filed level and made to fit the dish and cover respectively, they are "sweated" on, that is, as they are already filled with solder, they merely require to be heated so that the solder will strike. The handles are stamped in halves, filled and soldered together in the same way. Different ways and means are adopted for the mounting of different articles, but the principle is much the same as described above throughout.

The cheap tools used by mounters are flat, round, half-round, square, and other shaped files; rifflers shaped and bent to form so as to riffle in places which cannot be got at with a file. Scrapers and scoopers (Fig. 34) of different shapes are used where files cannot be employed.

FIG. 34.



SCRAPERS.

The fashioned article is then ready for the process of electro-plating, which can be roughly divided into three operations:—

(*a*). Preparing the surface to receive the electro deposit.

(*b*). The electro deposition of the metal.

(*c*). Finishing of the electro-deposited metal.

(*To be continued*).

THE COTTON PIECE GOODS TRADE OF SOUTH AMERICA.

Taking South and Central America as a whole, textiles form the most valuable item in the import trade, with the single exception of iron and steel manufactures. In the most thickly populated districts of the entire region, the climatic conditions are such that the clothing of the people must of necessity be composed mainly of cotton goods, and these, accordingly, form the most imporant item of the textile imports. In nearly all the countries, moreover, not only is the population increasing rapidly, but the *per capita* purchasing power is being augmented by development of national resources, and the consequent increase in the production of exportable goods. The demand for cotton manufactures is, therefore, not only large and increasing, but is likely to continue to grow for many years to come. The growing demand is, according to the recent report of a special commissioner appointed by the United States Department of Commerce and Labour, met in two ways—by importation from abroad and by home manufacture. Two of the countries, Brazil and Peru, have large supplies of native-grown raw cotton, and under the stimulus of high protective duties, home manufacture has developed with sufficient success to make it already a factor in determining the amount of imports. One or two other countries, notably Argentina and Uruguay, have followed suit, and have endeavoured to stimulate home manufactures, as well as the production of home-grown raw material by high protective duties, and other means, but they have met with far less success, partly through scarcity of labour for growing the raw material under climatic conditions, which are much less favourable than in Brazil or Peru. They are further handicapped by the lack o abundant fuel or water power for the running of their factories. Their protection of the industry, therefore, rests upon an unnatural basis, and it is not likely that it will result in any very serious competition with imported goods. On the whole, then, it would seem that, in spite of the growth of home manufactures in certain parts of Spanish America, the demand for foreign cottons will continue to increase with the growth of population and the rising purchasing power of the people. South America already furnishes a market for some £16,000,000 worth of European and American cottons, and it is not unlikely that the next few years will see the demand exceeding £20,000,000. The demand is for three or four chief general classes of goods, such, for example, as the finer and more expensive goods for the use of the wealthier classes of the community; plain, unbleached goods, for the making of clothing, flour sacks, &c.; dyed goods, made either from dyed yarn or dyed after weaving; and cheap prints, the demand for which is rapidly increasing. Fine goods of any kind are not manufactured in the native mills, their production being confined to the cheaper, coarser grades. Cheap, plain, unbleached goods, and dyed goods in immense variety of pattern, make up the bulk of the trade, whether

measured by value or by quantity, but the trade in cheap prints, though still relatively small, has made enormous strides in the past few years. So far as native competition is successful, it affects only the imports of the cheapest and coarsest grades of plain and dyed goods. The native spinning is all done by "ring" machines. The heavy sizing in the native mills, both before and after weaving, produces a cloth that cannot be very successfully printed. Nearly everywhere in South America there is evidence that the major part of the increase in demand in recent years has been in dyed goods and in prints. The most accessible field, therefore, for manufacturers, seeking to gain a foothold, lies in the direction of these goods, for which there is an increasing demand. Trade expansion along this line would not preclude expansion in plain bleached or unbleached goods as well; it would merely seem to be the direction in which first advances might best be made. The chief imports of cottons generally are of English and German origin, the former showing a marked tendency to decrease in recent years, while the latter have made equally notable advances. The Germans owe their success mainly to the fact that they have gone into the business on a large scale at a great expense, and with a determination to win. In the first place they carry on what may be called an international producing business. The most successful German manufacturer is not content to sell the products of his own German factory alone, but has purchased, or by contract gained control of the product of factories in other countries as well. There are instances in which a German factory thus controls the output of factories in Italy, Spain, England, France, &c. By this method the German producer has increased the variety of goods which he is able to offer to the South American market, and to maintain his hold on the sales of the particular classes of goods in the production of which his own home factory has special advantages. In the second place, the German exporter almost invariably places the selling of his product in the hands of a German house in South America, a house more or less directly connected with the home concern, and pecuniarily interested in its welfare. The home concern, or the connected house in South America, has in its employ, and constantly in the field, expert travellers, agents, or salesmen, who make detailed and frequent reports on the peculiar demands, not merely in any one country as a whole, but also in the various localities within a single country. These agents are technical experts as well as salesmen, and are able to estimate accurately the cost of making changes of pattern, &c., in response to varying demand, and to quote figures either on the spot or with a minimum of delay. Through their familiarity with the language and their close and frequent contact with the merchants, and even with the consuming public, they are able to form reliable judgments as to the standing of importing and retail firms, and to know at once what changes of fashion have taken place, or are likely to occur in the near future. They are thus able to arrange safely for the granting of the usual six, ten, or twelve months' credit, or for selling on open account, as is not infrequently done, and are able to meet promptly variations in demand. The Special Commissioner says that too many European and American producers sell to the South American market only when they have surplus stock to dispose of, and at such times they make all sorts of concessions, even to the selling of the goods at prices below the actual cost of production. The first step towards expansion of trade, is to convince exporters that there is a trade awaiting development which is valuable in itself, and capable of yielding good profits if properly carried on. With exporters sending out inferior agents, and selling to foreign middlemen, who have no direct interest in the home concern, and therefore use the business mainly as a source of profit to themselves, there cannot be much remuneration to the exporter on such business as is carried on. The middleman's profit, as well as many other items of expense, could be reduced to the benefit of the manufacturer or shipper, if the trade were taken up seriously, as a permanent enterprise. The exporter needs first of all to be convinced that there would be a profit for him in the building up of a permanent trade, and this can be done in only one way. Agents or commissioners must be sent out thoroughly familiar with every detail of the manufacture and trade at home, men who know costs, prices, and customary profits, and all the conditions under which the business is carried on.

AUSTRIAN TECHNICAL SCHOOLS.

To supply the needs of its population in industrial instruction, Austria has evolved a comprehensive system of primary and higher education, which is under the combined supervision of the Ministries of Instruction and Commerce. The schools have justly enjoyed a good reputation among other nations, even serving as models for similar institutions in some countries. The inception of Austrian industrial education was in 1872, the first period of development lasting until 1884. The second period continued until 1894, while the most important development has occurred since that year, the Austrian Government deeming it imperative to employ the most efficient means, owing to the industrial progress of the world, in order to meet competition with foreign countries. The main underlying purpose of the present method is to endeavour to form a close connection and interdependence between school and practice, and is contained in the following school types:—First, schools which give complete instruction in a certain trade. Second, schools in which tradesmen may obtain further instruction in their special trades. Third, schools giving preparatory instruction. The American special agent who has been investigating the systems of technical instruction in Austria, reports that after these twenty-five years' experience

in industrial education, the best results may be said to have been attained by those schools requiring as one of the terms of admission some years' previous practice in workshops, such pupils forming the most promising material, and proving the more eager students. The school types previously mentioned may be divided as follows:—First, central institutions of industrial education with higher aims, as the Austrian Museum for Art and Industry, Industrial Art School, the Technological Trade Museum, Institution for the Graphic Arts, Central Lace Course, and the Art Embroidery School. These in Vienna, with the Technological Museum at Prague, are all State institutions, having an attendance in 1906 of 2,435 pupils. Second, State trade schools, established for the purpose of furnishing general technical education in industrial arts and the trades. While these schools are not entirely uniform, the course of instruction in each occupies four years, and would-be pupils must have passed a period of eight years in the public schools, graduates on leaving these trade schools may become building contractors, independent tradesmen in any of the industrial arts, managers of industrial undertakings, &c. There are at present 21 schools of this type in Austria, having an attendance of 12,566 pupils. Third, special schools for the building trades to afford further instruction to journeymen carpenters, &c. These are a comparatively new departure, and thus far eminently successful in the two institutions already opened, with an attendance of 609 pupils. Fourth, special schools for specific trades. Many of these schools have been established with the object of meeting the particular needs of their respective localities, and, at the present time, there exist of this type, 82 State schools attended by 10,382 pupils, and 75 schools subsidised by the State. Fifth, schools for the handicraftsmen. Of these institutions in Austria, six are maintained by the State, where instruction is given to 2,222 pupils; and five are subsidised. Sixth, special schools for industrial drawing, of which there are four in the Empire. Seventh, general schools for further instruction in the trades, and in drawing. These include instances where the course is in connection with the public school. Altogether they number 1,000 schools, attended by 130,000 pupils. The schools are usually subsidised by the State, and for the most part supported by the municipalities. The Technological Trade Museum of Vienna is one of the most important institutions for industrial education in Austria. The departments comprise those for instruction in the chemical trades, including dyeing, food chemistry, and analysis for instruction in the metal and electro-technical grades, &c. The metal trade department consists of a lower and a higher grade. All pupils seeking admission must have reached the age of fourteen years, passed the examinations of the public school, and be considered physically fit. Such pupils are accepted on two months probation. The instruction covers matters of general education, and all things treated of in the metal industry, *i.e.*, language, mathematics (arithmetic, geometry, algebra, trigonometry, &c.), free-hand drawing, physics, mechanics, mechanical technology of metals, general chemistry (organic and inorganic), trade hygiene, and general practice in workshops. The course for the lower grade is concluded in four years, that of the higher grade for more advanced study necessitating attendance for an additional two years. The formal entrance fee is 3s. 4d., the cost for one year for Austrian youths £10, and for those of other nationality £15. In the department for electro-technics, which is also divided into a lower and higher grade, similar terms of admission (age and public school examination) are required. The lower grade occupies three years, and students are fully taught those things pertaining to electrical science and application. Two additional years are required for completing the course of the higher grade, and graduates are enabled to assume any position in the electrical branches. The entrance fee and cost are the same as those for the metal trade department, but in both instances, where worthy pupils are unable to pay, arrangements are made for partial or entire exemption from all expenses. This department was the second school of the kind to be established, a similar institution at Frankfort, in Germany, being the first. Very much is done by the Ministries of Instruction and Commerce in the way of advancing the trades and handicrafts, all means at their disposal being employed to assist the smaller tradesmen in withstanding the onslaught of the great manufacturing industries, This initiative is followed up by the different provincial authorities. In the Technological Trade Museum at Vienna is also a department, or school, established by the Ministry of Commerce, for furthering its endeavours towards the promotion of the trades. Instruction is given in wood working, metal working, chemical trades, plumbing, carpentry and joining, shoemaking, dressmaking, tailoring, &c. Tuition is here absolutely free, and, in addition, for those pupils coming from outlying districts, scholarships are provided sufficient in amount to defray all necessary living and travelling expenses. Most important and interesting are the small model shops connected with the school in operation, with their necessary attendant foremen and managers, while practical instruction is given in the several trades. Exhibitions of the products of students' labour are held from time to time. The shoemaker's course may be completed in six weeks, and includes anatomy of the feet, measure-taking, cutting, computing, &c. The Government allows scholarships for master shoemakers to the amount of £5, and for journeymen shoemakers to the amount of £4. At the beginning of the present year 975 persons, in 60 courses, had been instructed in these model shops. Six weeks are likewise devoted to the course in tailoring, and the same amount is allowed for scholarships as mentioned above for shoemakers. Fifty-three courses have already been completed, in which 852 pupils received instruction. The joiner's course occupies eight

weeks, during which a knowledge of the scientific treatment of woods is taught. The scholarships in this course are for Viennese master workmen, £7, and for journeymen £6. Thus all participants unable to provide their living expenses during the term of study are supported by grants, while to those living outside Vienna, the re-imbursement or scholarship is for master workmen, £11, and for journeymen, £8, thus making a provision for travelling expenses. The graduates of the 38 courses already completed number 505. Graduates of the carpenter's course, which occupies twelve weeks, are qualified for the position of foremen. These number 293, twenty courses having been given. The students entering upon this course are usually master workmen to whom the Government allows a scholarship to residents of Vienna amountiug to £8, and to non-residents £10. The course of locksmiths and tool-makers is eight weeks. Twenty-five courses have been taken, and 300 pupils graduated. The same amounts are granted for scholarships as in the joiner's course. In galvano-technical instruction, nine courses have already been completed, with a graduate list numbering 101 pupils. Viennese receive a scholarship of £7, others £8. Legal instruction pertaining to the respective courses is given in every case. Since the opening of this institution 3,026 artisans have been given instruction in 205 courses pertaining to their individual trades, the amount of whose subsidies has reached £16,000. The Government also maintains teachers who travel regularly in the provinces, giving similar instruction to pupils in remote country towns.

THE SUEZ CANAL.

In his report on the trade of Port Said and Suez, recently issued (Cd. 3280), Mr. Consul-General Cameron gives some interesting particulars of the expanding accommodation of the canal and its trade. During the last twenty years its navigable dimensions have practically doubled, the superficies of the vertical profile having been increased from 320 to 580 square metres in the ordinary channel, and to 740 square metres in the numerous gares or crossing places, the dredging being so carried out as to exceed the limits originally agreed upon. Between 1898 and 1904, owing to the increasing size of ships, larger gares were begun, some 20 in number, at intervals of three miles, each gare having an effective length of 820 yards, with approaches of 328 yards at either end. At each gare the bottom width of the canal is 50 yards, the width at the water level over 100 yards, the depth of the gare itself being 31 feet. Taking the canal as a whole, its width on the water level in the northern half, is from 100 to 120 yards, and in the southern half from 80 to 100 yards. In 1902 the maximum draught was raised from 25 feet 7 inches to 26 feet 3 inches (8 metres), and on January 1st, 1906, to 27 feet (8 metres 23 centimes). The mean duration of transit remains about the same, namely 18 hours for all vessels, but the general effective rate for mail steamers is 15 hours. The length of the canal is 100 miles, and the ordinary rate of speed is 6¼ miles per hour. The use of the electric light is practically universal, amounting to 97 per cent.

The tendency has been to lower the canal dues, but not rapidly, or to the extent that some think practicable. The original tariff for laden ships was 10 frs. per ton in 1869, which was raised to 13 frs. in 1874, but was lowered ½ fr. per ton from 1877, to 9 frs. in 1893, and to 8½ frs. in 1903. On January 1st, 1906, the tariff was reduced to 7 frs. 75 c., and from the same date the lighthouse dues in the Red Sea have been reduced from 14 to 10 millims. per ton for ships under 800 tons, and from 7 to 5 millims. for ships over that tonnage. For ships in ballast the canal dues have always been 2 frs. 50 c. less. The 10 frs. rate for passengers has never been charged. The transit receipts for last year were 108,161,896 frs., as against 113,866,797 frs. in 1904, the decrease being due to the reduction in the tariff which came into force at the beginning of 1906. 3,975 vessels, of a net tonnage of 13,445,504 tons, passed through the canal in 1906, as compared with 4,116 vessels of 13,134,105 tons in 1905, a decrease of 141 vessels, but an increase of 311,399 tons. It is satisfactory to find that British shipping continues on the whole to hold its own. Out of the total of 3,975 vessels 2,333 were British. The British net tonnage that passed through the canal in 1906 was 8,299,931 tons, a decrease of 57,000 tons as compared with 1905, but representing a percentage of the total tonnage of 61·7. And if only merchant vessels are taken, the British percentage of net tonnage rises to 74·7, the German percentage having risen 1 in recent years, from 15 to 16.

NEW GERMAN METHOD OF SHIPPING LIVE FISH.

The American Consul at Frankfort states that experiments made in Germany with reference to cheap transportation of live fish have demonstrated that all kinds of fish can live for days outside of their natural element, under certain conditions. This apparently wonderful fact will be easily understood by examining the breathing apparatus of fish. The gills of fish are an organ similar to the human lungs; the blood in them comes up close to the surface. The lungs exchange for the outside air, rich in oxygen, carbonic acid which has been formed in the lungs. On the other hand, the gills of fish are constantly washed by water containing oxygen. The thin membrane of the gills separates the blood in them, vitiated with carbonic acid from the water containing oxygen, and the practical result is the same as with the human lungs. Carbonic acid is exchanged for oxygen. It had been noticed long ago that many kinds of fish could live out of water

for some time, provided that the gills remained wet. The experiments made aimed at keeping the gills wet, and to see to it that this moisture be well charged with oxygen. In order to keep the gills wet, the evaporation of the moisture of the gills had to be prevented; for this purpose the fish were placed in an atmosphere thoroughly saturated with water vapour. A wooden box, hermetically closed, was filled with water to the depth of about one-third of an inch, or the bottom was covered with wet rags, which, through evaporation, kept the air in the box always saturated with water vapour. The fish were placed in a box which was then shut hermetically by the lid. Through a tube, reaching to the bottom, oxygen was introduced and allowed to escape through a tube in the lid. This oxygen, before entering the box, passed through several water bottles which thoroughly saturated it with water vapour. In this way the fish are always in a pure oxygen atmosphere, and a drying up of the gills is not to be feared. The result of the experiments was surprising. Carp, tench, and other fish remained in the box for from three to four days perfectly well. When they were then placed into water to be fed, they swam about in a lively manner and appeared perfectly fresh. The Consul says it is expected that this mode of transportation for fish will become popular, as it is much more economical than shipping live fish in water tanks. By the latter method the weight of every shipment was 93 to 96 per cent. water.

LOCAL INDUSTRIES IN PERSIA.

In his report on the trade of Persia just issued (Cd. 3283) Doctor Aganoor, Acting British Consul-General, shows how local industries are declining in Persia. The chief of these industries are cotton and silk weaving, and henna grinding. Many kinds of cotton and silk tissues are manufactured, also carpets called "zeloo." The latter industry seems to be increasing. A coarse gray cloth called "karbaz" is also manufactured. Nearly all articles of local manufacture are both consumed locally and exported to different parts of Persia, but most local industries are gradually declining, as imported articles can be retailed cheaper than articles of local manufacture. Manufacturers abroad are constantly obtaining samples of cotton and silk tissues manufactured in Yezd, which they exactly imitate. Another factor which tends in no small degree to cause the decline of local industries is the excessive "maliat" (taxes) levied by the local authorities on the industries. Only a portion of these taxes is accounted for to the Treasury, the balance being pocketed by the tax gatherer, who has to buy his position. Henna is imported from Bam and Khabis in the Kerman district, and after being ground it is exported to places all over Persia, to the Asiatic provinces of Russia, and to Constantinople. It is used for staining the hair and nails.

HOME INDUSTRIES.

Banks, Dividends, and Investments.—The past half-year was a prosperous one for banking interests. Owing to the condition of the money market profits were unusually large. For example, the Union of London and Smith's realised profits amounting to £279,204, as against £258,039 for the corresponding half-year of 1906; the London, City, and Midland has a sum available for distribution of £505,914, as against £448,663; and so with most of the leading banks. But there is little change in bank dividends. The only noticeable improvement is in the dividend of the Metropolitan Bank (of England and Wales), which is at the rate of 15 per cent. in lieu of 12½. The explanation of these stationary dividends notwithstanding large profit increases, is, of course, the recognition of the need for writing down investments and making provision therefor. As a rule the banks have not definitely stated the figure at which Consols are taken in their balance-sheets. They have contented themselves with setting aside a considerable sum for depreciation of investments; and in many cases the carry forward has been considerably increased. Quite possibly definite announcements will be made at the meetings of the banks. A few years ago some of these banks wrote down their Consols to 85, and in doing so they were thought by many to be unduly pessimistic, but now one bank has actually written down to 83, and there are authorities who consider that the figures should be 80. Whatever the point fixed, it is well to remember that the investments will remain at that figure, for a rise in the market price is not likely to induce auditors to "write up" assets. Meantime the sums set aside for depreciation are in many cases very large. The London, City, and Midland uses £50,000 for writing-down purposes; the London and Westminster has transferred £100,000 from reserve to a Government securities depreciation account; and so in varying proportions but always in considerable amounts. In the past half-year the average Bank of England rate was as high as £4 13s. 10d., in comparison with £3 13s. 11d. in the first six months of 1906, and of £2 13s. 9d. in the corresponding period of 1905. Even at the present level of prices the yields afforded by British Government securities are no more than about 3 per cent., the yield on Consols is still less than 3 per cent., and if the Bank of England's rate of interest averages for a whole half-year £4 13s. 10d., Consols cannot be expected to stand at a figure much over 3 per cent. It is indeed a little surprising, having regard to the immense creations of high class securities in recent years, the demand for money at high rates, and the activity of home industries, that British Government stocks have not depreciated to an even greater extent than that shown by present quotations.

Platinum.—Whatever may be the truth about new discoveries of platinum in Russia and North America, the rumours have had the effect of reducing the price

of this very rare metal very considerably. At one time last year the price was 150s. per ounce, or almost double that of standard gold. Not many years ago it could have been bought at 20s. per ounce. About the middle of April the price fell 20s. per ounce, and since it has receded another 30s., so that the present market price is about 100s. per ounce. Platinum is got, for the most part, from Russia, being found there in alluvial deposits mostly in the Ural districts. A little, too, is got from North and South America, but practically the world has hitherto had to rely upon the Russian supply, and the shrinkage in the Russian output is due to several causes. Since the Japanese war, and the internal divisions in Russia, labour has become scarce, there have been strikes, and more or less stoppage of works. Then the ore is of poorer grade. The mines have been impoverished by the exhaustion of the richest portions, and this entails the handling of a greater tonnage of mineral, which means a greater number of hands and increase in the cost of extraction. It is said that much of the ground worked upon at the present time yields less than 1 dwt. of platinum to the ton, and that even the high class of mineral ground does not produce more than from 2 dwt. to 3 dwt. On the other hand the demand for platinum continues to grow, and is likely to grow even more rapidly in the future. For it is used in many of the most growing industries. It is used largely in the electric lighting industry. Each electric lamp requires two little platinum wires sufficiently long to pass through the glass of the bulb so as to ensure a perfect vacuum, without which the lamps will have no durability, and as the manuacture of these lamps increases by millions a year the demand under this head alone is large. It has been attempted to find substitutes, and it is now claimed that a satisfactory substitute has been discovered, but it remains to be proved. Platinum is said to be the only metal upon which diamonds can be mounted. Platinum is used again in the process of platinotype photographic printing now so common. Then there are the requirements of the dental and chemical industries, and the ignition apparatus of motor cars. Platinum is essential owing to the exceedingly high melting point (1,775 deg. Cent.), which enables it to withstand intense heat. And it resists strong acids. At the moment the trade seems to be sufficiently supplied, but prices are not likely to go much lower. It is not thought probable that the new discoveries of platinum will do more than meet the growing requirements of the various industries using it, if indeed they do as much.

The Tweed Trade.—Probably no trade has been more adversely affected by the rise in the price of raw material than the tweed trade. The principal raw material of the Scotch tweed trade is wool, and for three or four years past the price of wool has been rising steadily, and although there were expectations of reaction in the cheaper grades prices remain at about their highest points. In the case of some grades the rise in price, as compared with former years, amounts to a hundred per cent. But whilst there has been such a serious increase in the price of the raw material the tweed manufacturer has been unable to raise his prices in corresponding degree, or, indeed, at all. The demand is good and increasing. During the last twelve months the South of Scotland tweed trade has been exceptionally busy, and to-day it is as busy, if not busier, than it has been for years. But there is little profit in it for the manufacturer. No adequate advance can be obtained in the price of the manufactured article, so that the greater portion of the advance on the cost of wool has to be borne by the manufacturer. The tailor who supplies the consumer has a standard price for a suit of tweed, and does not see his way to raise the price to his customers, so that he cannot pay more for the cloth to the merchant, who is the middleman between the manufacturer and the retailer. The merchant pays a little more per yard for the cloth which he shares with the retailer, but the brunt of the loss has to be borne by the manufacturer and spinner. It might be thought that this state of things would bring about concerted action between the manufacturers, but this would inevitably lead to substitution of lower qualities, or of mere imitations. In other branches of the textile trade the prices of the manufactured article more or less rise and fall with the cost of the raw material, but, as matters stand, this is not the case with the tweed manufacturer. Already he has to reckon with imitations. Cloths are woven, more particularly in Yorkshire, to imitate Scotch tweeds, and are largely sold as such. These imitations closely resemble the genuine article, and even an expert cannot always detect them at first glance. Made of inferior materials the cloth can be produced at much less cost than the genuine article, and since the recent rise in the price of wool, the trade in it has grown to great dimensions. A committee of the South of Scotland Chamber of Commerce has for some time past been inquiring into this "substitution" trade, but the difficulties in the way are many. Nor is it only from England that the Scotch manufacturers have to reckon with what they consider unfair treatment. A large quantity of foreign spun yarn, mostly Belgian, is used in the manufacture of tweeds, and the Scotch spinners feel the competition of worsted yarns, now used for a very considerable portion of the best Scotch tweeds, one reason being that worsted goods cannot be so successfully imitated in shoddy or woollen goods. Most of the worsted yarns are got from Yorkshire, many of the Scottish manufacturers having dispensed with carding plant altogether. It is surprising that nothing has been done with regard to the registration of a general trade mark to protect goods of Scotch manufacture. The establishment of a standard for Scotch tweeds, defined as "fabrics made from Scotch wool, carded, and spun, and dyed and woven in Scotland," would seem to be very necessary.

Railway Rates for Coal.—Reference was made in these Notes a week or two ago to the alteration in the rates for the carriage of coal, coke, patent fuel, and breeze. The change came into force on July 1st, and has evoked mnch protest. Meetings of coal traders have been held in most of the important centres of the country, and there has been general agreement as to the need for resistance. The London Coal Merchants' Society are preparing a petition to the Board of Trade, but meantime the rates have to be paid. The objections taken to the action of the railway companies are that the notice given was inadequate, seeing that the traders' long contracts have just been entered into, that the increase is equivalent to 2½ per cent. on the charges, and that the change abolishes the old-established custom of an allowance for the "wastage" that is inseparable from shunting operations, &c.

Iron and Steel.—It looks as if the trade of the world in iron and steel has for the present reached its maximum, and that certain declines are to be expected, even though the volume of trade may be intrinsically good. It is noteworthy that Cleveland pig iron warrants have recently dropped to 55s., and that Cumberland hematite warrants have receded to 76s. Both the German and American demand for iron have been continued for an unexpectedly long time, and even in June shipments to both America and Germany were large, but they were nearly all against contracts booked earlier in the year. The new orders are few, and although there is a good deal doing in home industries there is a falling off in new business. The steel trade is fairly active, but activity in shipbuilding is declining. It would seem then, whether regard is had to the indications from abroad or at home, that the abnormal demand for pig iron has ceased, or is about to cease. Once America and Germany leave off taking from us more will come upon the general market, where the consumption is not increasing. In the iron and steel industries, as the rest, the lean years follow the fat.

GENERAL NOTES.

Machinery for Cultivation of Vineyards.—The Paris *Moniteur Officiel du Commerce* of 13th June (quoted in the *Board of Trade Journal*), announces that the Italian Ministry of Agriculture will hold an international competition for machines adapted to the cultivation of vineyards. The competition will take place in Palermo in the course of next autumn. The machine adjudged best will be awarded a diploma and 10,000 lire (about £400) and the Ministry of Agriculture will purchase two of this class; the second prize consists of a gold medal and 3,000 lire (about £120). Applications for admission to the competition must reach the ' Direzione Generale dell' Agricoltura," Rome, by the 15th September next; they should embody full particulars of the dimensions, weight and power of the machines which it is proposed to exhibit, and of their mode of working, and any other details which may be deemed useful.

British Shipping and Rotterdam.—The figures of British shipping which entered the port of Rotterdam in 1906, supplied by Mr. Consul Twining, in his report (Cd. 3283) recently issued, show that the British preponderance was well maintained. Of the total shipping entering the port 39½ per cent. taking numbers, or 38½ per cent. taking tonnage, was British, which compares with 37 and 35 respectively in 1905. Next to the British total of 5,635,371 gross tonnage comes that of Holland, 2,843,079 tons, and Germany, 2,558,666. Taking all nationalities, the gross tonnage entering the port in 1906 was 14,572,246 tons. In the decade 1897-06 the tonnage of the port increased from 8,434,032 tons to the above-quoted figures of 14,572,246 tons. Mr. Consul Twining refers to the reduction in the commission charged for the transmission of wages and the poundage for money orders from 3d. to 1d., and says that there has been a consequent increase in the number of money orders issued. The amount of wages payable in 1906 on the termination of the respective voyages was £80,148 15s. 2d., and of this sum £22,598 13s. 4d., or 28 per cent., was remitted to the United Kingdom by 1,926 men, representing 25 per cent. of the number discharged at the Consulate; the respective percentages in 1905 were 26·44 and 24·28.

Lace and Tulle Manufacture in Calais.—During the last two years the lace and tulle manufacture, the staple industry of Calais, has been very prosperous. In a special report recently published by the United States Consul, and referred to and endorsed by Mr. Consul Payton in his report upon the trade of Calais just issued (Cd. 3283), says that up to December 10, of last year the exportation of Calais lace to the United States alone amounted to £1,660,000, and the completed year would show a total exportion to America of between £1,800,000 and £2,000,000. The Consul had known cases of single invoices amounting to £8,000 and £12,000. He also referred to the enlargement of factories and building of new ones, and stated that lace-workers were earning from £4 to £8 per week. But Mr. Consul Payton says it must be borne in mind that this is principally piece-work, the men being paid so much per rack, and that, while skilled and industrious workers may get paid at the rate, many of them receiving their pay on Saturday do not return to work till Tuesday or even Wednesday. Several small new factories have been built, and one large one increased by a big new wing, which will probably bring its capacity up to about 200 machines. A good machine costs about £1,000 to £1,200.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The results of the Advanced Examinations (Stage III.) have been published and copies have been sent to all centres for distribution to candidates.

The results of the Intermediate Examinations (Stage II.) will be published early in August and of the Elementary (Stage I.) at the end of that month.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

PROCEEDINGS OF THE SOCIETY.

APPLIED ART SECTION.

SHEFFIELD PLATE AND ELECTRO-PLATE.

By Sherard Cowper-Coles.

(*Continued from p.* 866.)

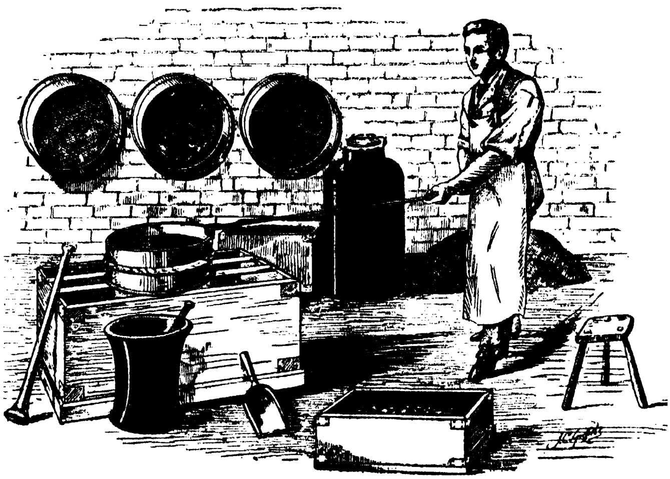
Polishing.—The first operation an article has to undergo when it leaves the hands of the workman who finally fashioned it, is to render the surface quite smooth and free from blemishes and scratches, which is done by a process of abrasion by a polishing or buffing machine. Men and women are employed on this operation, which consists of applying the article to rapidly rotating leather wheels or discs, made out of walrus hide or other hard leather, screwed to the end of a revolving spindle. The abrasive material is fine sand, (mixed with a little oil), which is carefully prepared by a system of grinding and screening, such as shown by lantern slide (Fig. 35). The sand is constantly being lifted from the tray into which it is projected by the revolving discs, and applied to the object under treatment by means of the hands.

When replating old work such as Sheffield plate, the silver is stripped off in an acid solution, and in many cases the article is then scoured by hand, instead of buffing or polishing on a lathe. Scouring is done by means of hard brushes and sharp sand or pumice powder (Fig. 36). If a higher degree of polish is required the wheels or discs composed of layers of calico are used, to which lime is applied instead of sand, the lime being carefully burned and placed in air tight jars until required for use.

Removing Grease and Cleansing.—The next operation is to remove the grease left by the process of polishing and handling, which is done by dipping the articles in a tank of hot

caustic soda, or potash solution, either by placing the articles in baskets or perforated trays (Fig. 37), or dipping them, if of large size suspended by wires or copper hooks (Fig. 38). The objects are usually wiped over

FIG. 35.



PREPARATION OF MATERIALS FOR POLISHING.

FIG. 36.

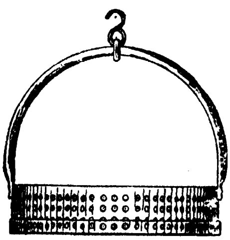
SCOURING.

with a soft cotton mop to ensure the removal of any adherent grease or soap formed by the saponification of the grease. The articles are then rinsed in water and taken to a bench where they are attached to wires by women, ready for suspending in the electro-depositing bath.

The method of wiring such articles as spoons is shown in Fig. 39; the position of the wire is changed several times during the process of depositing silver, so as to avoid wire marks which would otherwise occur.

Quicking.—The next operation is to dip the articles in a solution of cyanide of potassium and mercury, called quicking, to ensure the proper adhesion of the silver coating, after which it is struck, that is, the articles are put

FIG. 37.



DIPPING TRAY.

in a striking vat, where a comparatively high current density is employed, so that the articles become instantly coated with silver when immersed in the electrolyte. They are then removed and thoroughly scratch brushed, that is, brought into contact with rapidly revolving wire brushes on which a weak solution of size or stale beer is allowed to trickle.

Many articles after the polishing and the removal of all grease are dipped in acid to

remove all oxide and then in running water prior to quickening.

Depositing the Silver.—The articles are then placed in the silver depositing vat, Fig. 40,

FIG. 38.

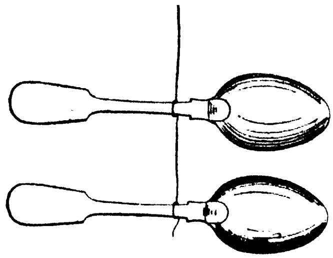
REMOVAL OF GREASE.

FIG. 40.

DEPOSITING VATS.

where they are allowed to remain for a number of hours, according to the thickness of the metal required. The vats are provided with reciprocating or rocking frames so as to keep the solution agitated, and thus ensure a more even distribution of the silver. The anodes or plates through which the electric current

FIG. 39.

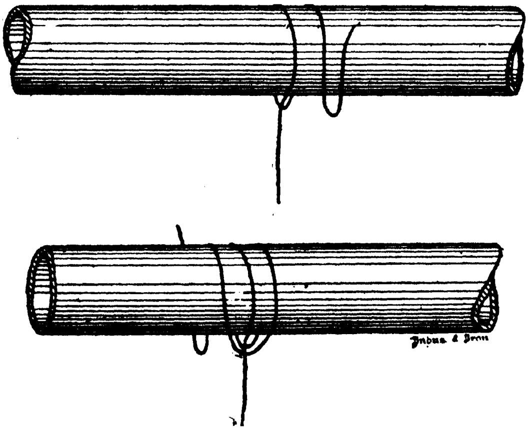


METHOD OF WIRING.

passes in the solution, are made of rolled silver, which is cast into bars. The articles are weighed before and after plating, so as to determine the weight of silver deposited, the particulars being registered by means of records. The method of attaching the wires suspending the articles to be plated to the electric conductors is shown in Fig. 41.

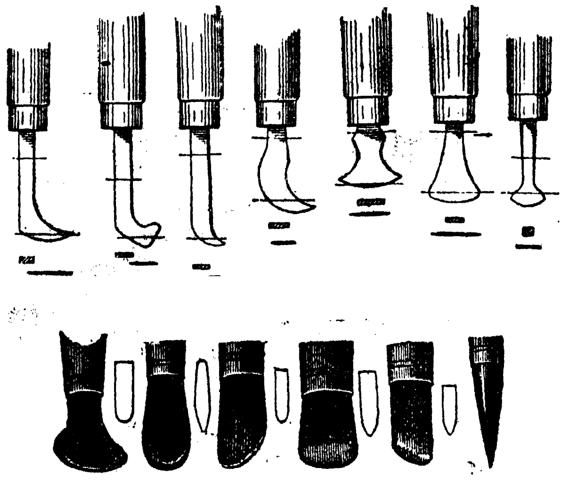
Burnishing.—The final process consists of burnishing or polishing the silver, so as to obtain the bright surface usually appertaining to electro-plated articles. If the articles are to be burnished, they are again scratch

FIG. 41.



METHOD OF ATTACHING WIRES TO SUSPENSION RODS.

FIG. 42.



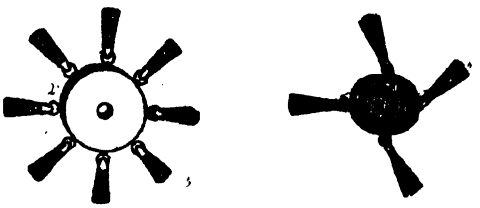
BURNISHERS.

brushed or scoured, and then handed over to women who use steel or agate burnishers of a variety of shapes (Fig. 42), to suit the different objects under treatment, the burnishers when melted on the surface break down the crystalline structure of the deposited metal. The surface thus obtained is streaky, and is therefore subjected to a further process of polishing known as colouring, which consists of rubbing down the surface over with rouge. This is either done by hand or on revolving swansdown mops. Spoons, forks, and such like articles, are usually rough burnished by men, then finished on calico mops with lime, and finally coloured with rouge. When the silver object is required to have a frosted or dead appearance, the articles are scratch brushed with a special construction of scratch brush, called swing brushes or hammers (Fig. 43), which have a beating action, and give a dead or matted appearance, or they are subjected to an impinging jet of fine sand, propelled by air pressure. Prior to the process of finishing, if the objects are hollow, they are usually dried out in hot boxwood sawdust.

Bright Silver Plating, which was the next discovery of importance, was due to an accident, and arose in the following way:—Messrs. Elkington and Co. used moulds for making silver electrotypes, composed of a mixture of wax and resin, the surface of the mould, for the purpose of electrical conduction, being covered with a film of phosphorus by means of a solution of phosphorous in bisulphide of carbon. These moulds were put in a cyanide silver-plating vat, together with other work, and it was observed that many of the articles came out bright, or partly so, and this led them to add bisulphide of carbon to the plating vat, with the result that, after some experimenting, good, bright deposits of silver could be obtained, instead of the frosted white deposits which are usual. A patent was eventually taken out in the joint names of Millwood and Lyons.

Bright plating, although useful for some purposes, is not employed so extensively as it was originally anticipated it would be, the solution being somewhat difficult to manage, even when in skilful hands. The appearance of bright plating is also very inferior to burnished or finished work, and does not keep its lustre for so long. It is chiefly used for very

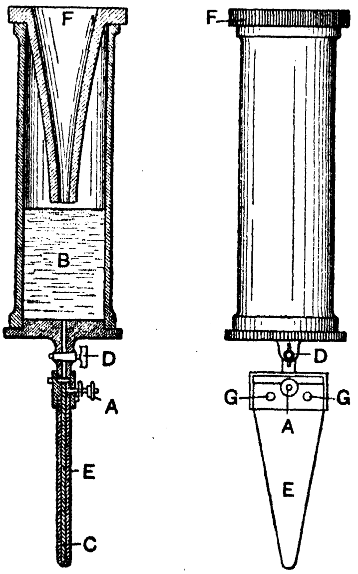
FIG. 43.



SWING BRUSHES OR HAMMERS FOR FROSTING.

cheap electro-plate, which merely requires to be coloured with silver so as to give it a finished appearance. It is also employed for coating articles with deep hollows, which are required to be bright, and could only be burnished with great difficulty. According to an analysis made by Gore, bright silver plate contains sulphur.

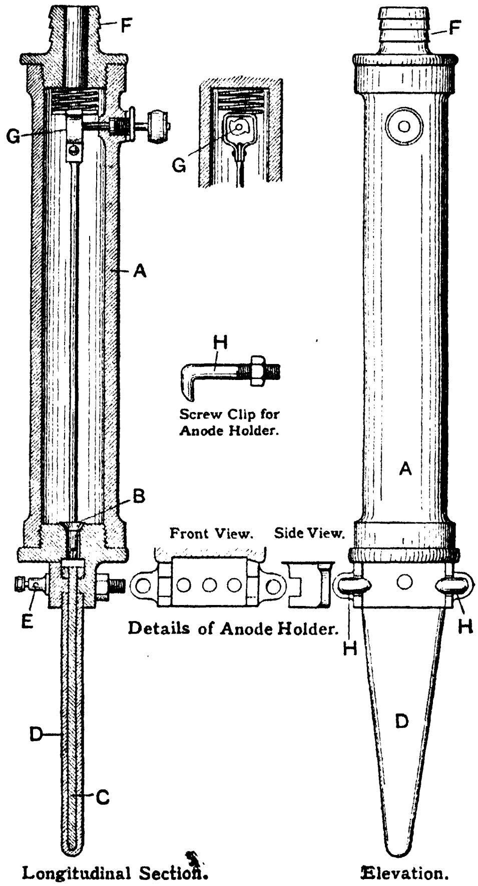
FIG. 44.



RESERVOIR DOCTOR.

Differential or Localised Electro-plating.—It is often desirable to partially coat one metal with another by electro-deposition, and occasions arise when it is not possible nor desirable to place the whole of an article in a plating bath. In such cases coating the article locally by electo-deposition is resorted to, and is commonly called "doctoring" or "ragging," and is accomplished in the following manner:—The work to be doctored is connected with the negative wire of the battery or dynamo, and a small piece of the metal to

FIG. 45.



DETAILS OF DOCTOR.

A. Reservoir.
B. Cone valve.
C. Anode.
D. Absorbent covering.
E. Positive terminal.
F. Connection for flexible hose.
G. Cam for actuating valve.
H. Clamp.

be deposited is wrapped in some soft absorbent material such as swansdown, and is connected with the positive wire. The anode thus prepared is dipped in the plating solution and moved over that portion of the article which it is desired to plate for a minute or two, this operation being repeated. The process of ragging is employed for two purposes—for

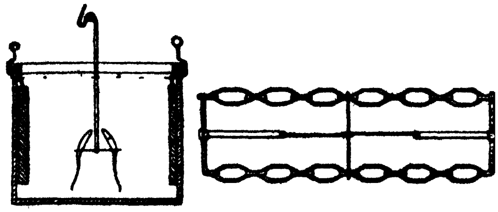
doctoring or patching up the electro-deposited metal on an article when it has been removed by some accident, or by careless work in the final operations of polishing and finishing, or for coating portions of articles which have been previously plated and then riveted or soldered up. Fig. 44 shows a doctor that is always ready for use. The plating solution is contained in a reservoir, which forms the handle, the speed of flow being regulated by a cock. The reservoir is kept supplied with the plating solution by means of a flexible tube connected to a tank placed a few feet above the operator. When necessary, the anode and its envelope can readily be replaced by loosening two set screws The doctor is held in the right hand and passed slowly over the surface to be coated. Fig. 45 shows the detailed construction of such a piece of apparatus A doctor in use attached to a rheostat for the regulating of the current density is shown in Fig. 46.

FIG. 46.

DOCTOR IN USE.

Fig. 47 shows Buck's apparatus for insuring a deposit of silver of varying thickness upon spoons, forks, or like articles, which are subjected to more wear upon one side than upon the other. The bath is arranged with two anode planes, and the articles to be plated are suspended in two planes, interior to the anode planes, with their surfaces outwards, upon which it is desired that the heaviest deposit of metal shall be produced.

FIG. 47.



BUCK'S APPARATUS FOR VARYING THICKNESS OF DEPOSIT.

A vat for plating spoons, forks, and similar articles is used in which the thickness of silver is distributed according to the wear on the different parts. After the

articles have been adjusted in the rocking bar, the flow of the plating solution is regulated into or out of the vat by some such arrangement as shown in Fig. 48, when the level of the electrolyte is gradually lowered by means of an adjustable syphon, in order to prevent the formation of a line of demarcation between sary inclination is by means of set screws placed at the side of the vat. In some cases it is advantageous to arrange for the automatic reduction of the current as the cathode area diminishes. The anode is preferably placed in a horizontal position near the bottom of the bath.

FIG. 48.

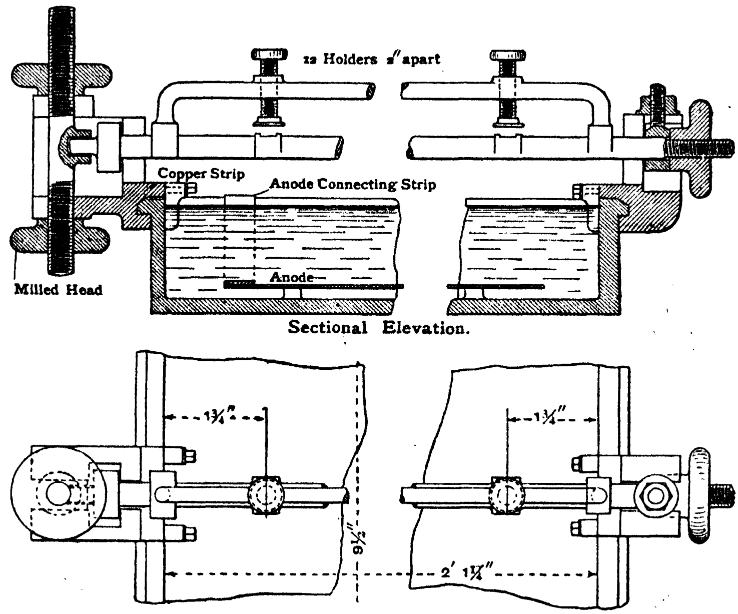
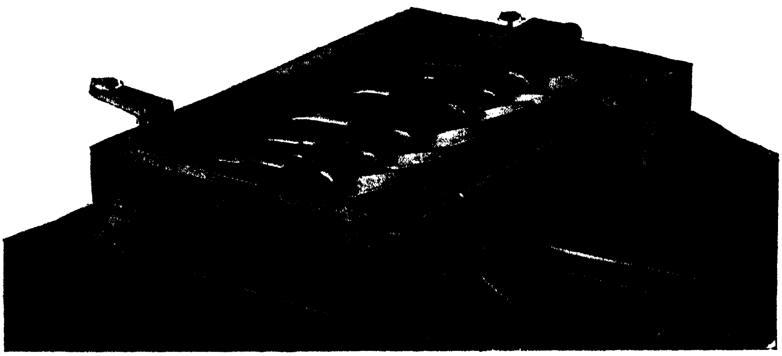


FIG. 49.



APPARATUS FOR THE DIFFERENTIAL PLATING.

the thick and thin portions of the deposited metal, so that the cost of polishing and finishing shall be no greater than is the case with articles plated in the ordinary way. The electrolyte should be freely agitated, so as to prevent the accumulation of any free cyanide of potassium on the top of the solution. The adjustment for giving the articles the neces-

Some manufacturers solder silver tips to the ends of the prongs of their best quality forks, but this only partially remedies the evil, as there are other portions of the fork which receive excessive wear. In America spoons and forks are manufactured with sterling silver let into those parts which receive most wear, the points of rest, or contact or wearing are

inlaid with standard silver, the whole being ultimately electro-plated.

All who use electro-plate will have noticed that the silver coat becomes entirely removed from those parts that receive most wear,

FIG. 50.

GENERAL ARRANGEMENT OF A PLATING SHOP.

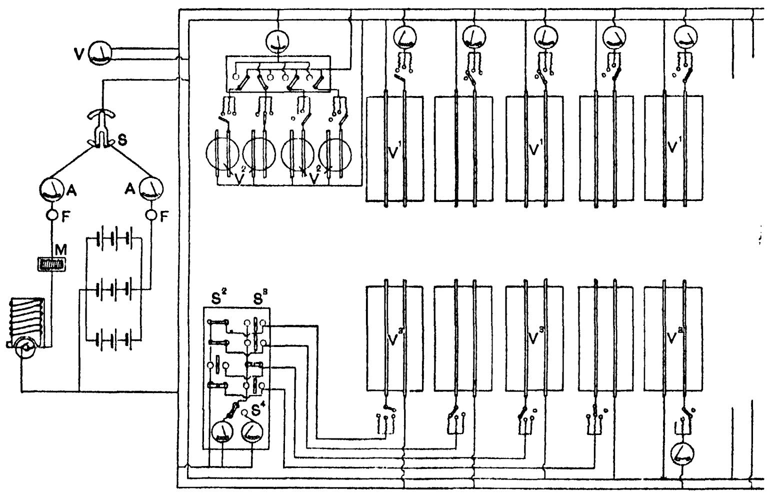
whilst the remainder of the plating remains almost as good as when new. It has doubtless occurred to many that if the coating metal could be distributed during the process of electro-deposition in such a manner that the wearing parts received a very thick coat and the non-wearing parts a comparatively thin coat, silver-plated articles could be produced which would wear two or three times as long as similar articles coated with the same weight of silver, the silvering being evenly distributed over the whole surface, or, expressed in other words, about half the weight of silver only would be required to produce articles having equal wearing properties.

Rudholzner, for the purpose of enabling the thickness of the deposit to be varied at will, arranges in the bath between the article and the anode, freely suspended plates of insulating material, provided with larger or smaller apertures. By this means, the parts of the article which are directly opposite the apertures, receive a thicker coating of metal than those parts which are protected more or less from the direct action of the current by the insulating plates.

Fig. 50 shows the general arrangement of a plating shop, with the scouring trough, the caustic soda cleansing solution, next to which is placed the tank containing the hot sawdust for drying hollow articles. Then there is the striking vat, and the tank of clean water in which the articles are swilled, so as to prevent the loss of the silver solution adhering to the articles. At the end of the shop are shown two scratch brush lathes.

Fig. 51 shows the general electrical and switch-board arrangement of a plating shop, the tanks being worked in parallel, matters being so arranged that when the dynamo is not running the accumulators can be switched into circuit to take its place, and Fig. 52 shows the general arrangement of a small plating shop.

FIG. 51.



GENERAL ELECTRICAL ARRANGEMENT OF PLATING SHOP.

The Electro-disposition of Silver Alloys.—Silver, which is the metal most largely deposited for ornamental purposes, is open to the objection of costliness and softness. It is well known what a marked effect a slight admix-

ture of some element when added to a pure metal, will make in its characteristics. It may be safely surmised that if by some such slight admixture, an alloy would be produced by electrolysis, having the appearance of pure silver, with the additional advantages of hardness and resistance to tarnishing influences, the discovery would possess an indisputable value. The chief work that has been done in this direction is with alloys of cadmium and silver, which have been successfully deposited on a commercial scale. The process consists of casting anodes of the same composition as the alloy to be deposited. An alloy of 30 per cent. of cadmium and 70 per cent. silver when rolled, develops a remarkable crystalline formation, breaking up into a series of triangular strips as shown in Fig. 53. If it is desired to deposit an alloy of this composition, cast anodes must be used, not rolled. The electrolyte is composed of the double cyanides of potassium and silver and cadmium. The relative proportions of the two metals in the solution cannot be based upon their electro-chemical equivalents, as a number of other important factors control the composition of the alloy deposited.

FIG. 52.

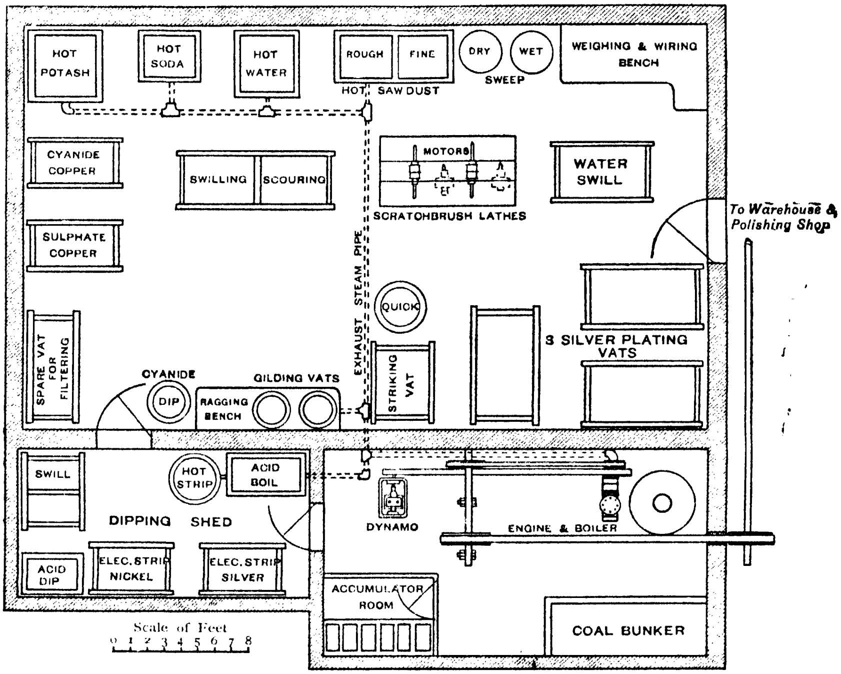
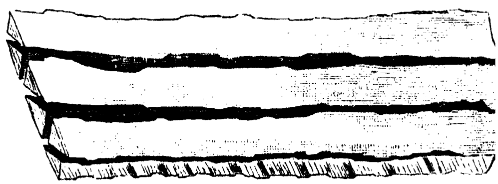


FIG. 53.



The results of many hundreds of experiments, show that the minor differences between the two metals, play a very important part; there is an electro-motive force between the two metals, independent of the electro-motive force of the cell; further, the current that will deposit 40·248 grammes of silver, will only deposit 2·076 cadmium, whilst there are considerable differences between the resistance of their respective salts in solution.

If an electrolyte be made up, containing a certain number of ounces of metal per gallon, and deposits be obtained at various current densities, the percentage of silver contained in the alloys will be different in every case, and different for every composition of solution, consequently it is only after much time and trouble and careful experiment, that the laws connecting the percentage of the alloys deposited, composition and density of solution and current density can be obtained. The

foregoing remarks readily indicate the laws governing the deposit of silver and cadmium.

A solution, whose metal contents are two or three ounces per gallon, and which contains a large amount of cadmium, gives at very small current densities, which alone are practical on account of the smoothness of deposit required, deposits varying from 40 per cent. to 100 per cent. of silver, whereas a solution containing eight or nine ounces of metal to the gallon, gives 80 per cent. or 90 per cent. of silver for a very large range of current density.

For any given solution, the percentage of the more positive metal increases with the current density, but the variation is not one of simple proportions. If the solution be a weak one, patchy deposits are the result of using too high current density, and the metals are not deposited as a true alloy. The relation between the percentage of the electro-negative metal and the electro-positive metal at a given current density, can be varied by agitating the solution or moving the electrodes. If the bath is weak in metal and the anodes are not dissolving freely, the resistance will be altered, consequently the current density and the nature and composition of the alloy will vary. In short, it may be said that for every composition and density of solution, there is a different current density required to give a definite composition and alloy, and if the electrolyte is to be maintained for any length of time in working condition, the deposit must have the same composition as the anode. In order to check the working of the bath, small platinum test pieces should be employed, so that the composition of the deposit can be readily ascertained.

During the last few years numerous investigations have been carried out, with the object of determining whether there are any other practical methods of rendering silver less tarnishable. Amongst the series of experiments that have been made may be mentioned the deposition by simple immersion, the electro-deposition of various metals such as tin, zinc, cadmium, chromium, on the silver surface to be rendered less tarnishable, which was then baked in hot air or high melting point waxes, so as to cause the silver to absorb the thin film of deposited metal. Another series of experiments consisted of subjecting the silver coated with the metals above referred to, to pressure under various conditions, also electro-depositing on the silver surface under pressure. A fourth series of experiments consisted of making various amalgams and applying these to the silver surface, and then driving off the mercury by heat.

Some of these methods have given promising results in the laboratory, but when put to a practical test, were found unreliable. One of the chief difficulties encountered was the retaining of the true colour of the silver, and, at the same time, alloying the silver sufficiently deep to ensure it withstanding the final polishing and finishing operations, there being a tendency to penetrate the alloy on the edges, and most prominent portions.

On the table will be found some specimens of silver-cadmium alloys deposited in various percentages, also ornamental electro-silver objects, rendered non-tarnishable by a new process of hard lacquering, which ensures a very hard, even coating in intimate contact with the underlying silver.

CONCLUSION.

Electro-plate, from an economist's point of view, offers many advantages over Sheffield plating, as the metal of which the electro-plated objects are made is much harder than the copper used for Sheffield plate, and is, therefore, less liable to be bruised and dented. On the other hand, silver electro-deposited is softer than the silver rolled on by the Sheffield process. When the silver becomes worn off in places in electro-plate, the contrast of colour between the copper nickel alloy and the silver is not so pronounced as between the copper and the silver in Sheffield plate. The joints in electro-plate are hard soldered not soft soldered as in the case of Sheffield plate, and the thickness of silver in electro-plate can be more easily distributed so as to be thicker in those portions that receive most wear.

It is to be hoped that England, which was the birthplace of Sheffield and electro-plate, will continue to take the lead in this important industry. Although the art of electro-plating has been brought to considerable perfection, there remains much to be done, and it is a fruitful field of investigation for the electro-chemist. Electro-plating in many large establishments is still carried on by rule of thumb, with much waste of material and the production of an unnecessarily large percentage of faulty articles which require to be replated or doctored. It is to be hoped that before long all such works will be managed on truly scientific lines, with resulting economies. Research work must be systematically carried out to bring about those improvements

and developments in the industry undoubtedly will be evolved before long. Electrochemistry is taking an important place in almost every branch of industry, and electrochemists now have their own society, the Faraday Society, established for the purpose of promoting the study of electro-chemistry and electro-metallurgy. Many problems remain to be solved in connection with the silver electro-plating industry alone, some of which have already been referred to, and it is to be hoped that the birthplace of this important industry will be the first to bring any important improvements to a practical issue.

In conclusion, I should like to thank the authorities at South Kensington for the loan of the fine specimens of Sheffield plate exhibited here to-night, and also the Chairman, Sir John Bingham, for the beautiful specimens of electro-plate, which are particularly interesting as the mouldings are stamped from the same dies originally used for making Sheffield plate, the only difference being that in the former case they were stamped in thin silver, instead of a copper nickel alloy, and then coated with silver by electro-deposition.

DISCUSSION.

The CHAIRMAN, in opening the discussion, remarked that the essence of success in competitive undertakings was the method in which manufacturers conducted their business. He did not believe that the author had been over his (the Chairman's) works at Sheffield, and he would be delighted if not only that gentleman but the whole of that scientific audience would take the opportunity of inspecting the two miles of benching at his works, because if they would only come and see the actual processes of manufacture they would gain a much greater amount of information than could be given in any lecture or speech. Dr. Wright, of Attercliffe, and his (the Chairman's) late revered partner, George Walker, really discovered electro-plating, but the first conception of the idea was Dr. Wright's, to whom the whole of the honour in that connection was due. It was in his opinion only proper that Sheffield should have the honour of the discovery of electro-plating, because it had eventuated in a very great business indeed in which many tons of silver were annually deposited. The author had stated that the difference between electro-plate and old Sheffield plate was that the one, I believe, had less silver upon it than the other. That entirely depended upon how much silver was put upon the Sheffield plate, because electro-plate could beat old Sheffield plate if the customers would only go to the expense of the necessary silver. The base or under part, nickel silver, if made by a good house should be quite white, and almost impossible of detection when the silver had been worn through. A really good house would use silver solder, but common houses used a darker coloured nickel which wore through yellow, and they also used soft solder which was liable to go to pieces, as it often did, and had sometimes given electro-plate a bad name. The best quality electro-plate was a great deal more valuable than light sterling silver goods, and although it cost only about one-third the price would wear much longer. He did not desire to run down silver goods, because he made many tons of them in a year, and was just as pleased when he received an order for silver as for electro-plated articles, but thin silver was of no use. Friends had frequently sent silver-backed hair brushes to him to have their names engraved on them, but it was impossible to do the engraving because the tool went through the silver in a moment owing to its thinness. He could support the evidence the author had given in the slides he had shown on the screen. The audience would remember there was one mark consisting of cross keys and H.W. That firm manufactured Sheffield plate for over a hundred years, and he (the Chairman) was fortunate enough to bid more than anyone else for their dies when they were sold. He had tons of those dies, and was only sorry that the taste of the present day did not sufficiently permit of their use. He was sorry more old Sheffield plate designs were not used. In its future manufacture he would suggest, however, that instead of being plated upon copper it should, on account of the colour, be plated upon nickel silver. He would have the greatest possible pleasure in sending to the whole of the audience a little pamphlet containing a number of pictures of his works and the processes conducted.

Mr. FIENNES DAVENPORT enquired whether the process of old Sheffield plating was ever performed upon a base of brass.

Mr. COWPER-COLES replied that, as far as he knew, the base was always copper. He believed the reason was that copper and silver had a great affinity, recent researches having shown that a low melting point alloy was obtained with those metals in contact. The silver probably gave off a vapour and combined with the copper; the two surfaces formed a low melting surface alloy, and made a union between the two. He believed manufacturers had not been successful in using brass.

The CHAIRMAN stated that manufacturers had not been successful in using brass for close plating purposes. The discoverer of close plating was a gentleman who wished to use some silver and copper soldered together, but he made the ingot too thick. Instead of filing it he took it to one of the old time Sheffield mills, which were very primitive undertakings then, where it was slightly rolled down. Looking at it

when he received it again, he was surprised to find that the silver and copper had rolled out about evenly; and being a man of thought he had it further rolled, with the result that it rolled down into a sheet. He also found that the sheet of silver, with the soft solder under it, and the copper under that, had all rolled down evenly. Brass was harder than copper, and copper and silver rolling as they did—just equivalently—were right for the purpose; but hard brass, compared with the softer copper, would not roll in the same proportion, and, therefore, would be useless for close plating.

Mr. T. T. GREIG remarked that he had always been under the impression, until hearing the paper, that the material for Sheffield plate could be obtained by the single process of rolling the silver on to the copper cold, as the Chairman had suggested; but, on the other hand, the author stated it was done between two ingots, heat being applied. Was it a fact that the Sheffield plate material could not be obtained without heat, or could it be rolled cold?

The CHAIRMAN replied that Mr. Greig was quite right and also quite wrong. If a sheet of silver and a sheet of copper were soldered together they rolled out equivalently when rolled cold, but in the first instance heat had to be applied to solder the silver to the copper.

Mr. GREIG inquired whether, with modern electroplating, if an article were used for a short time, but not by any means worn out, and then sent to the manufacturer to be electro-plated with a view of getting a richer and thicker coat of silver on it, it was necessary to rub or scratch off, as he understood the author to say, the old electro-plate before putting on the new coat. If that were so it would be no good sending an article two, three, or four times with a view to getting a richer and thicker coat of silver upon it.

The CHAIRMAN replied that a good deal of nonsense was talked about double, treble and quadruple plating. No one who had any brains would attempt to do it in the way the speaker had described; they would put the plating on all at once. In his works it was known to a nicety how much plating would be placed on an article in a vat with a given amount of electricity. It need not be sent several times to the works to be re-dipped. It was not at all necessary that the plating of silver should be taken off. If the plating was very much worn away in one part and the silver was thick in other parts, they sometimes took it off and put the whole coat on evenly again; but there was no necessity to do that providing the silver was put on firmly, which was now an easy thing to do. He remembered the time when the silver was put on very crudely, and when it had to be filed level, because the manufacturers did not know their business; and many a time it fell down in the vat as real silver sand and would not adhere at all. All those things had been done away with now. The article could be taken out of the vat ready for burnishing and finishing off; and if an article was sent to them with the request that a coat of silver should be put upon it, it was not necessary to disturb any plating which was already upon the article, it would be sent back to the owner finished, and he would not know it from a new piece of goods.

Mr. RATHBONE was under the impression that ordinary electro-plate ware was apt to blister if it was soldered when being repaired, but he imagined from what had been said about the preparation of old Sheffield plate that that danger would not exist in that class of article. He believed it was the custom in some kinds of solid silver ware to electro-plate the work before it was polished. If such an article had to be repaired at a later time, and he was right in thinking that an electro-plate deposit of silver was apt to blister under the blowpipe, that danger would exist. It seemed to him to be a great argument in favour of old Sheffield plate if it was free from such danger; but, perhaps, he was altogether wrong in his surmise.

The CHAIRMAN replied that Mr. Rathbone was altogether wrong. In old Sheffield plate the silver coating was practically soldered on to the copper base. If a close-plated knife was held in the gas or a candle, the silver would strip off in a sheet; if a wine-cooler was held against a flame the solder would bubble up underneath the silver ground; and the silver would strip off because the solder would melt. It was not the case that solid silver ware had silver deposited on it in the process of manufacture before polishing; but occasionally, when there was so-called fire in the process of manufacture which made the silver a shade streaky and red in parts, it was sometimes slipped into the vats to obliterate that fire. If it was properly done the article could then go into the market; if not, it had to be slightly brushed. If such an article was heated red-hot afterwards, it did not cause any blistering, in fact, the amount of silver which went on was infinitesimal.

Mr. RATHBONE asked how, if the solder which attached the silver to the copper in the old Sheffield plate melted so readily, it was annealed in the process of beating it up into shape.

The CHAIRMAN replied that that could not be done, otherwise the article would be blistered. Nickel silver was annealed many times, and silver was only annealed for convenience sake. Silver would not blister when deposited upon nickel silver; but silver being more easily melted than nickel silver, if electroplate was subjected to a great heat the silver would run.

Mr. HUGH STANNUS thought the paper would be most valuable as a work of reference, and that the members of the Society would read it with great interest when it appeared in the *Journal*. He had stated before, at a meeting, that he thought it would be a very desirable thing if some of the Sheffield manufacturers would take a leaf out of the book of their Japanese brethren in the manufacture of silver ware. The Japanese could teach Europeans a good many things in applied arts, as also in other directions. For instance, in their method of mixing alloys, while they had not exhausted its possibilities, they had undoubtedly shown all silver-workers the way to introduce a great deal of beauty of colour. Silver here was merely one bright colour, which was very pretty and dear to the British housewife; but every artist who had a liking for colour would prefer that his silver work should be oxidised and tarnished. He had a pair of very beautiful old silver candlesticks which were a magnificent bronzy kind of colour, but a British servant girl, armed with whitening, cleaned them, scratched them and spoilt their beauty. He thought a distinction might be made in silver articles between the portion which was put into the mouth and the portion which was handled. A difference was made in the case of the knife, there being a steel portion and an ivory portion; and he suggested that in a spoon one portion might be made of a Japanese alloy and the other of silver plate. The author when referring to the process of spinning had said it was confined to round objects, by which he meant objects which had a circle as their sectional area; but as a matter of fact it was a regular thing to spin objects which were elliptic in plan. When an object was round and it spun on the centre of motion, every portion of the circle being at the same distance from the centre, all that the workman did was to hold his wooden tool and push the plate of metal on to the solid matrix which gave the shape of the cup, basin or whatever the article was. If it were an ellipse, however, obviously as it was farther from the half-longer diameter than it was from the half-shorter diameter, the centre had to move backwards and forwards, and when the shorter diameter came against the tool the centre was closer; when the longer portion came against the tool the centre was moved back, and so it kept moving. He did not know whether that was an exclusive patent but he had often seen it carried into effect; every lady would know it as used in dish covers, which were elliptic in plan. He thought the members were very much indebted to the author for his thoughtful and exhaustive paper, and sympathetically agreed with his suggestions that more science should be applied in the manufacture of silver objects. If it paid a brewer to keep a trained chemist, surely it would pay a silver plater to do so; and he quite expected to hear that the Chairman in his great factory at Sheffield had a trained chemist to help in the supervision of the electro deposit. The Chairman, by his remarks and the explanations he had given, had materially added to the interest of the paper, and laid the audience under an obligation.

Mr. W. M. MORDEY remarked that the author was one of the hardest workers on electro-metallurgical subjects, and combined in a singular degree a knowledge of the scientific side of the subject with a knowledge of and sympathy with the artistic side. Mr. Cowper-Coles had produced more than one admirable new process in metal work and in the application of science to artistic work in metals, and he was sure all had learned a great deal by listening to his paper on such an interesting subject. As an electrical engineer, he (Mr. Mordey) desired to support the suggestion that more science should be put into the manufacturing process of electro-plating. He had not had the pleasure and privilege of going over the Chairman's works, but he had been through other large electro-plating works, and he had been surprised at the crudeness of the electrical applications, although he could not but admire the excellent results that were obtained. He desired to ask the author to state in his reply whether much so-called old Sheffield plate was now being made—a good deal of it was seen on the market. It was rather a curious thing when one thought of it that old Sheffield plate really began by being a sham; it was covering up a base metal with a nobler metal. It showed what a curious thing fashion was, because people now prized the old Sheffield plate more if they could see the base metal underneath—actually prized it for the very object that people strove to hide when the method was first introduced. Personally he had been expecting and hoping that more objects of ordinary use would be made of solid silver, as silver, at the present time, being little more than two shillings an ounce, was very much cheaper than in the days when electro-plating was first introduced. That process, however, was not at all likely to disappear.

Mr. COWPER-COLES, in reply to Mr. Mordey's question with regard to the manufacture of old Sheffield plate, said he was told that a large quantity was being manufactured at the present time on the Continent and in Denmark. Copper articles were made and then electro-plated, some of the silver being rubbed off from small portions in order to make them look like old Sheffield plate. There were a great number of those articles now on the London market, and it was only by careful examination that one was able to detect the fraud. He thanked the audience very much for the kind way in which his paper had been received, and also the Chairman for specially coming up from Sheffield to preside. His practical knowledge in connection with old Sheffield plate and electro-plating had been of the greatest benefit to all.

The CHAIRMAN, in proposing a vote of thanks to Mr. Cowper-Coles, reiterated his invitation to the members to visit his works at Sheffield, where he

would be only too delighted to show them all the processes described in the paper. The remark had been made that old Sheffield plate was a sham, but it had also been beneficial because it had prevented a good deal of thievery. A learned judge once said that one of the benefits that electro plating had given to mankind was that it had saved a great many people from crime. He had seen specimens of electro-plating which had lasted over forty-five years. He did not think such articles could be called a fraud, and the purchaser of them could not have been taken in much. He was quite sure that the present light silver articles would not wear a quarter of the time that good electro-plate would.

THE PRODUCTION OF GRAIN AND FLOUR IN MANCHURIA.

Although an immense stream of Chinese immigration has flowed into North Manchuria from the south during the last ten years, only narrow borders along the rivers and routes of travel have been settled. Vast districts in the north and west yet remain only partially explored. The chief occupation of the settlers is agriculture. The valleys of the Sungari, the Mutan Chiang, and the Nonni rivers, together with the bordering plains of North-Eastern Mongolia, comprising an approximate area of 70,000 or 80,000 square miles, possess a soil and climate especially suited to the production of wheat and other grains. The agricultural possibilities of these districts have scarcely been touched. At the beginning of the construction of the Eastern Chinese Railway, ten years ago, the Chinese population in all North Manchuria did not number 1,500,000, and was chiefly centred around Kwanchengtze, Kirin, Petuna, Sansing Ninguta, Tsitsihar, and a few other small centres, The American Consul at Harbin says that the principal agricultural products were "kao-liang," or tall millet, "hsiao-mi," or Italian millet, "huang-mi," or the common German variety of millet, wheat, dry-ground rice, barley, maize, and buckwheat. The surplus of these products was transported by cart to the south during the winter, when the ground and streams were frozen, and carting was easy. Upon the arrival of the construction forces of the railway, and later the military forces, there was a large demand for grain and flour which it was necessary to supply from abroad, and which on account of the inconvenient transportation facilities, was very expensive. The surplus production of wheat in North Manchuria at that time did not amount to more than 500,000 bushels a year. In order to supply the sudden demand the Chinese were ordered by the military authorities, under pain of punishment, to sell their grain to the supply departments of the Russian army and the railway. This caused a temporary check in the production, but the steadily increasing demand forced up the prices, especially of wheat. As the demand was the greatest for wheat, the production of that grain took the lead. The production of grain in North Manchuria in 1905, as estimated by the Chinese brokers in Harbin, in bushels, was as follows:—Wheat, 21,000,000; kao-liang, 12,000,000; beans, 12,000,000; both varieties of small millet, 13,000,000; barley, 6,000,000; oats, 900,000; and rice, maize and other grains, 6,500,000. Of the total production of 21,000,000 bushels of wheat, 13,500,000 bushels were marketed, the balance having been retained in the districts for consumption and seed. Owing to the severe winters and the light snowfall, so that no protection is afforded against frost, winter wheat is not grown in North Manchuria. The Chinese farmer usually plants only such areas as he can attend to himself, seldom employing help. The ground is prepared as soon as it thaws in spring. The surface is well worked, but deep ploughing is not practised. The grain is planted in rows, about ten inches apart. The weeds are kept out, and the surface of the ground is usually stirred twice during the growing season. Only the simplest kinds of ploughs and other farming implements are used. The harvesting is done by hand, and the wheat in the head is stacked for threshing, during the winter, on the frozen ground. The average yield is from seventeen to twenty-five bushels per acre. The grain is threshed out by stone rollers, and by treading. As farming mills are not generally used, the grain when brought to market is usually very dirty, containing from fifteen to twenty per cent. of foreign matter. As the threshing is a winter occupation, the new grain does not come upon the market until late, and after the navigation on the rivers is closed. The smaller farmers send their grain to Harbin or other markets by carts, from distances of from sixty to two hundred miles. On account of the high rates of transport, very small quantities of grain are transported to Harbin by rail. The flour milling industry of North Manchuria is an outgrowth of Russia's railway extension and military occupation of Manchuria. These two branches have been the main sources of the demand for this flour. By the withdrawal of the army, the industry received a sudden and severe check. Before 1900, there was not a modern flour mill in North Manchuria. The large demand for flour from the army and railway which developed at that time was supplied from abroad, chiefly from America. In order to obtain a cheaper article, and at the same time to develop Russian industries, the Russian authorities encouraged the erection of flour mills. In August, 1906, at the time of the withdrawal of the main forces of the Russian army, there were in Harbin twelve mills, with a total daily capacity of 6,000 barrels, and since then one of these mills has completed extensions which give it an additional daily capacity of 2,000 barrels. In addition to these there are eight mills in other parts of North Manchuria having an aggregate daily capacity of 3,000 barrels per day. While several of these mills are equipped with obsolete machinery, the plants more recently put up are quite modern and of perfected type. For instance, the

Sungari mills, which have a capacity of 3,000 barrels daily, are equipped with electric power and the latest improved German machinery. Unfortunately for the industry nearly all these flour mills have been built with borrowed capital, on which extremely high rates of interest have been paid. One of these mills which was indebted, on account of advances and other obligations, to the extent of nearly £81,000, was recently bought up by the Russo-Chinese Bank for £10,000. Recently the four largest flour milling companies in North Manchuria, the Sungari Company, the Zozulinsky Company, the Kavalsky Company, and the Myakoff Company, controlling the six largest mills, formed a combine and sent representatives to St. Petersburg to secure additional capital with which to liquidate their obligations, increase their capacities, and carry on their operations. About £516,000 was secured. The combined capacity of these mills at present is nearly 7,000 barrels of flour daily. This is to be increased to 10,000 barrels in the near future. It is the intention of the proposed combine to control the flour markets of North Manchuria and Siberia, and also to enter the markets of Japan and China. In order to encourage the combine the Eastern Chinese Railway Company has made a special rate for Manchurian flour from Harbin to Vladivostok, on condition that it is for export. A few of the smaller mills have declined to enter the combine at the present time, partly on account of the doubts they entertain as to the ultimate success of the undertaking, and partly for the reason that they consider that the larger mills cannot be worked as economically as their own. A noticeable feature in connection with the flour mills of North Manchuria is, that while some of the first mills put up are equipped with American machinery, nearly all the machinery recently installed is of German make. This is the result of the German makers having a branch at Moscow, whose representatives made periodical visits to Harbin, and keep in close touch with the flour milling interests there. The chief obstacles that appear to be in the way of Manchurian flour competing successfully with other flour in the outside markets are: (1) the primitive and wasteful methods of the Chinese farmers in the cultivation of wheat, and (2) the high cost of transportation of the flour. The farmers more than lose the advantage that their cheap labour gives them by not employing modern implements and machinery, not properly working the soil, and not cultivating improved varieties of grain. Their custom has been to sell the best and save the poorest grain for seed. An examination of the wheat as it comes to market, shows that several varieties are cultivated together, some of which are almost worthless, and greatly reduce the percentage of flour obtained, as well as the yield of grain from the land. However, in view of the closer attention that the Chinese authorities are commencing to give to the development of the economical resources of North Manchuria, it is probable that these unfavourable conditions will be gradually removed. The Consul says that the Manchurian field offers fair opportunities to any large farming implement and machinery makers who would undertake to develop a market in Manchuria by establishing an agency, either at Harbin or Kwanchengtze, with branches in the principal agricultural centres, where they could demonstrate to the farmers the advantages of modern implements. The Japanese and German manufacturers are already finding markets for cheap ploughs and other implements. It will be of little avail for manufacturers to attempt to sell their goods from catalogues or through correspondence, especially in the English language, when the Japanese and German manufacturers have active representatives in the field. The Chinese wish to see the goods and understand how they work before buying. In conclusion, the Consul says that if manufacturers wish to secure markets in Manchuria, and hold them, they should go there and sell their own goods, and not trust to houses there that have no special interests in their affairs to represent them.

COTTON-GROWING IN QUEENSLAND.

The great importance, from the national point of view, of increasing the area of cotton cultivation within the British Empire is now generally recognised, and much useful work has been done in this direction, more especially by the British Cotton Growing Association. The difficulties in the way of rapid development of cultivation are many, and perhaps the greatest of all is labour. There are many parts of the world where climate and soil are suitable to the growth of cotton, but few where labour is sufficiently plentiful, efficient, and cheap to make it a commercial success. It is this fact which has given the Southern States of America the predominant position they hold as cotton producers. They have the finest supply of cheap labour in the world. At the time of emancipation it was feared that the cotton industry would be ruined from the want of labour, that the free negro in the Southern States would become an intermittent worker only, as in the West Indies and elsewhere. That fear has not been realised. Whatever his faults the negro of the Southern States is a splendid worker, and he is content with a low wage. In no other country is there such a magnificent supply of labour suitable for the cotton field. But the peril of depending mainly upon the Southern States for the cotton requirements of Lancashire becomes greater every year. At the time of emancipation Great Britain took the great bulk of the cotton grown. But since then, and more especially of late years, the American home demand has increased enormously, and, concurrently, the requirements of the continent of Europe, not to speak of the United Kingdom, have grown rapidly. On the other hand, whilst the area of cultivation in the Southern States has increased, the increase has not been in proportion to the growth of the demand, and

although the exports from Egypt, India, and elsewhere have increased, the world's dependence upon the Southern States does not lessen. The danger to the United Kingdom of this state of things has only recently led to a serious and organised attempt on the part of Lancashire to improve the position by encouraging the growth of cotton within the British Empire. This growth is necessarily slow, but there are grounds for hope that at no very distant date Lancashire will draw much of her cotton supply from Greater Britain. The recent history of tea cultivation shows what can be done in this direction. Within the memory of men not yet very old practically the whole of the tea consumed by the people of the United Kingdon came from China. To-day the supply from that source is insignificant. Almost the whole of the tea consumed is from India and Ceylon, that is to say from within the British Empire. What has been done with tea may conceivably be done with cotton.

Of all the dependencies of the Empire there would seem to be none more suitable for cotton growing than Australia. Seven-eighths of the Australian continent, or 2,576,362 square miles, is within the latitude south of the equator, which might be devoted to the cultivation of cotton. The best qualities cotton can be grown in the Northern Territory of South Australia, Queensland, and New South Wales in unlimited quantities; but the population is scanty. In the Northern Territory, with its 335,116,800 acres, there are only about 900 whites and 2,700 Chinese, in addition to the aboriginal population. So suitable are the climate and soil for the growth of cotton, that it has disseminated itself without the help of man, and may almost be considered as part of the North Australian flora. Of the eight species of cotton, seven varieties are found in the Northern Territory. The harvest of the ripe product falls almost wholly in the dry season, so that the picking is little interrupted by rain, which in the Southern States of America not infrequently spoils much of the crop. The annual cultivation of cotton is a problem requiring for its solution chemical and botanical knowledge in addition to practical experience. The present commanding position of the Southern States of America in cotton cultivation is largely due to its well-organised and splendidly-equipped experiment stations, conducted by the Department of Agriculture, and constantly engaged in scientific investigations into the many problems which arise, and in the collection and dissemination of information. It may be hoped that the South Australian Government will see its way to act upon Mr. John Bottomley's advice to establish an experimental station, and a seed farm where agricultural experiments in cotton may be carried out, and where selected seed may be grown for distribution to cultivators.

The question of the labour supply is the crucial one in Australia, as elsewhere, but it would seem as if the problem can be solved in Queensland. Reporting on cotton cultivation in that State, under date April, 1904, Mr. Bottomley, who as an expert on cotton cultivation is an admitted authority, wrote, "Given authority to offer on behalf of the Cotton Growing Association, say 1¾d. per lb., as a minimum price during the coming three seasons, we were assured that large areas of land now under maize would revert once more to cotton, and a large export trade to Lancashire would result without any probability of cessation even if prices lowered somewhat. With added experience, and improved varieties, cotton can, we are sure, be grown in Queensland cheaper than in any country in the world." It is a little surprising that, so far as Queensland is concerned, the Association has not acted upon this suggestion of its own reporter. In Mr. Bottomley's opinion, "Queensland is well suited for the immediate settlement of thousands of cotton growers who, in a short time, can make a good living from the industry." Mr. Bottomley puts the cost of production, including packing and every expense of tillage, and transit from plantation or farm to seaport at from £3 to £4 per acre, allowing for labour, on the basis of white wages. With yields of raw cotton, ranging from 1,000 to 1,600 lbs. per acre, this should pay. As to labour, there would seem to be a fair supply of "odd job" men who are not unwilling to take up light work, such as cotton picking at a moderate wage. Mr. Bottomley's estimate of cost would seem to be borne out by Mr. Daniel Jones, of the Queensland Agricultural Department, who recently put the cost of cultivation of an acre of cotton at £3 16s. 2d., made up as follows:—Two ploughings, 17s.; two harrowings, 2s.; drilling and sowing, 1s. 6d.; three scufflings, 4s. 6d.; thinning and hoeing, 3s.; carriage, 5s.; seed, 1s. 6d.; picking, ½d. per lb. (£2 1s. 8d.); total, £3 16s. 2d. The yield was put by Mr. Jones at 1,000 lbs. at 1½d., which would give £6 5s., and leave a profit of £2 8s. 10d. Assuming this estimate to be near the mark (it seems a moderate one) it will be seen that the profit is only small, since nothing appears to be allowed for rent, but it would probably be sufficient, if only it could be relied upon, and there was certainty of a market, to induce a considerable area of cultivation.

ORIENTAL CARPETS.

The carpet industry is in a very flourishing condition both in Persia and in Asia Minor. The market value of the carpets may be the same in the two countries, yet a great difference exists in the way they are made. This applies not only to the various shapes and lines, but to the grouping of forms and colours as well, which enables everyone unskilled in the business to distinguish between the make of Smyrna and that of Tabriz. The article which is sold in the world's markets as the celebrated Smyrna carpet is not made in Smyrna; it is a product of the vilayet of Aidin, of which Smyrna is the capital. According to a recent report by the American Consul at Smyrna, the chief places of manufacture are the villages of Uschak,

Koule, Ghiardis, Makri, Malessos, Kirkagatsch, Axar, and Demirdji. The production of carpets in Asia Minor is essentially a home industry, and the natives are exceedingly skilful in their handiwork. The industry gives employment and a means of livelihood to thousands of needy people, especially women, who are obliged to do the work almost entirely, while the men spend their time in the coffee houses, drinking strong coffee and smoking numberless cigarettes, all in true Oriental fashion. Little girls are compelled to take up the work early, at 7 or 10 years of age at the latest, and they keep to it unceasingly all their lives. Some efforts have recently been made to introduce the carpet factory system into Smyrna, which have, however, been attended with indifferent success. Labour is dearer in Smyrna than it is in the country districts, and the girls and women must pay more for food and lodging in that city than in the country villages. Many claim that the work done on the looms at Smyrna is more exact in measurement and neater in appearance for the reason that the manufacturer or merchant is able to superintend the operations at any time of the day, thus preventing mistakes which might prove fatal to some beautiful design. The looms set up in Smyrna, and worked by some sixty girls, number twenty. On the whole the experiment does not seem to be a success, and the number is not increasing. Uschak carpets are made in two styles. They are made either of spun wool or long wool, those of the former costing from 4s. 1d. to 6s. 9d. per square yard, the latter 10s. 2d. to 20s. 6d., according to the design and colour, and the size of the carpet. The web and the woof of the Uschak carpets are made of the wool of the fat-tailed sheep. The men wash this wool in the rivers, and the women comb and twist it softly in such a way as to allow the threads of different colours to blend lightly on the edges, in the same way as the different tones of a picture. The market for the wools, which have been thus spun and coloured ready for the carpet weavers, is held every Thursday, from dawn to sunset, in the bazaar of Uschak, which is then filled with purchasers, who have arrived on buffaloes, camels, donkeys, and other beasts of burden. The spun wools are not dyed by the weavers themselves, but by special dyers. For a short time artificial dyes were used, but their use was soon abandoned in favour of the better taste displayed by the admirers of Oriental carpets, who desired the ancient models and colours, thus reviving the use of vegetable colours extracted from madder, yellow berry, and valonia, and other products of the country, and from indigo brought by caravans. More than three thousand female weavers are employed at Uschak in the preparation of carpets. The looms are set up in about one thousand houses. The workers in each house are generally members of the same family, but there are, in addition, a number of girls employed, who earn about sixpence a day. The Ghiardis carpets are generally smaller than those of Uschak. Very fine prayer carpets, closely woven, and of harmonious colours, are produced in imitation of the Persian carpets. The dimensions of these carpets average five to seven feet by three feet ten inches. The weavers of Koule and Ghiardis use wool of a superior quality to that of the Uschak weavers for the woof, while the web is made of hemp. Large carpets as well as prayer rugs are made in Koule. In the village of Demirdji the carpet industry was for some time neglected, but ancient Oriental models having again come into fashion, the industry has improved, and the district now produces a very fine carpet, thick and closely woven, soft, and very strong. The web is of cotton. It is estimated that the three centres of carpet manufacture of Ghiardis, Koule, and Demirdji produce more carpets than the Uschak. Their prices are also a little higher, for they sell at not less than thirteen shillings and sixpence to twenty shillings and sixpence the square yard, the superior qualities at from forty shillings and ninepence to sixty-eight shillings per yard, and for certain old carpets which have become very rare the prices are exorbitant. The annual production of these carpets is estimated at 440,500 square yards, worth £280,000. The carpets are made into bales of 280 pounds each, and covered with goat skins. The caravans pass the night in the open country at the foot of some hill, the drivers under tents, and the camels and their loads in the open air. Very large carpets, too heavy to be packed, are folded and thrown across the backs of the camels in the form of a covering. When the carpets arrive in Smyrna they are spread out, beaten, brushed, and repacked in bales, weighing from five hundred to six hundred pounds each, for exportation to different parts of the world.

HONITON LACE-MAKING IN DEVON.

The revival of lace-making in Devon has just been reported upon by the Lace Committee of the Devon Education Authority as being very satisfactory in the adult classes held at Honiton, a large number of people having visited the town in order to see the lace, and, at the instance of Lady Northcote, a recommendation was made that an exhibit of lace made at these classes should be sent to the forthcoming Australian Exhibition. Lace-making is one of the crafts included in the scheme of the Higher Education Committee for the county, and some time since an instructress was appointed to superintend the classes that might be formed in the county, but the difficulty has been that local committees in small centres have been unable to obtain the necessary services for teaching. The report acknowledges that more teachers are wanted, but owing to expense they cannot be supplied It is anckowledged that a great advance has been made in the industry during the last two or three years, and it is unfortunate that the revival and development of such an interesting and profitable occupation for our female rural population should be crippled for the want of funds.

HOME INDUSTRIES.

Cloth Hearth-rug Factories. — Reporting upon industrial changes and developments, Miss Slocock, one of the lady inspectors of factories and worshops, says she had the novel experience in Huddersfield of inspecting a trade which was dying for want of workers. She visited the cloth hearth-rug factories and workshops, and heard the same complaint everywhere—that it was impossible to get workers. It is rough, heavy work, and the trade has got a bad name in the town, so the respectable women will not allow their daughters to go into it, and most women prefer to work in the mills if possible. The rugs are made from tailors' clippings, which are twisted round coarse twine, and woven on a hand loom. They are neither artistic nor very cleanly, being veritable receptacles for dust and dirt, but no rug as warm, or that will last so long, can be made at the price, and, consequently, there is still a large demand for them. Miss Slocock found in two or three cases the manufacturers were starting the works in other towns, transplanting one or two of their weavers to teach the women the trade, and when she visited Huddersfield later she was told that this experiment was proving satisfactory. The workers in this trade in Huddersfield had matters entirely in their own hands; they were all piece workers, and came and went as they chose. The system of fines for being late, and of selling the damaged work to the weavers, appeared to have been abolished, owing to the difficulty of obtaining workers, but there was a lack of discipline and order, and, except in the case of one or two workplaces, it was entirely in the hands of very rough, low-class women.

Cardiff.—The opening of the new dock at Cardiff calls attention to the really wonderful progress of that port during the last half century. In 1851 Cardiff was a town of 18,351 inhabitants, with a dock water area of 20 acres, and an aggregate import and export trade of less than a million tons. To-day it numbers 200,000 inhabitants, its dock accommodation covers 300 acres, with a trade of 25,000,000 tons, and it has become the greatest coal exporting centre in the world. It owes everything to the development of the South Wales coalfields. It has no great industries. A number of industries have indeed been established, and the port has become a ship-repairing and flour-milling centre, but it is not a great manufacturing or industrial centre like Newcastle or Glasgow. It is in its commerce and its shipping that Cardiff excels, merchantising as it does 70 per cent. of the coal product in the South Wales coalfields. It was between 1870 and 1890 that Cardiff developed most rapidly, and this increase was due to many causes, among them the increase in the size of steamships; the gradual displacement of sailing vessels by steam tramp vessels; the construction of the Suez Canal; the discovery of the superiority of Welsh steam coal over all other known coals for bunkering purposes; and the extension of the great railway systems of Great Britain and the continent. The output of South Wales coal rose from 13½ million tons in 1870 to 31 million tons in 1892, and the trade of the port of Cardiff grew from four million tons to some 14½ million tons. During these twenty years South Wales held practically a monopoly of the coal trade for railway, naval, and bunkering purposes in South Africa, India, and the Far East, and although since then the monopoly has ceased, the output of coal has grown continuously until in 1906 it amounted to nearly 47,000,000 tons, or 51 per cent. above that of 1892, whilst the trade of the port of Cardiff rose from 14,500,000 tons to 25,500,000 tons, an increase of 75 per cent. Nor has the growth of Cardiff as a shipping and ship-owning port been less remarkable. Fifty years ago Cardiff owned only a single steamer, a small coaster of about 600 tons dead weight. In 1906 she owned 250 steamships ranging in dead weight up to 10,000 tons, and representing an aggregate coal carrying capacity of over 1,250,000 tons. In 1870 the number of vessels cleared from the Bute Docks was 6,892, with a total net register of 1,618,733 tons. In 1906 the total number of vessels which cleared from the docks was 9,483, with a net register of 4,855,012 tons. The total tonnage cleared from the port of Cardiff in 1906 amounted to 9,961,502 tons as against 10,846,625 tons from Liverpool and 16,527,768 tons from London. If foreign cargo clearances alone are taken into account, Cardiff stands first with a tonnage of 8,089,773 tons, as against 7,291,039 from London, and 6,657,002 from Liverpool.

Harvest Prospects.—Although it is too soon to express any opinion upon yields, men of experience can say whether crops are healthy, with average growth and development for the time of year, and in accordance with its practice for many years past *The Times* has collected a number of reports from experts which show that while corn crops have suffered from excess of moisture and low temperature, grass is exceptionally abundant, and hay crops are heavy. On the whole the correspondents of *The Times* report favourably on the condition of most crops, but they are anxious as to the future. Complaints as to the backward, cold, and wet character of the season run through all the reports, but notwithstanding these adverse influences the figures show that the corn crops reached the end of June without serious injury. The writer of the digest, speaking from personal observation of the southern, eastern, and midland counties, says that on cold, stiff, lands the corn crops had evidently been seriously injured, and appeared yellow in colour, and very backward, but upon the warmer and lighter soils these crops looked well, although late, and oats were particularly vigorous and brown in the flag. Beans also were for the most part luxuriant. The wheat crop is likely to be less this year than last in England, and the decrease in Wales and in Scotland promises to be more serious than in England. Barley, too, is less promising than last year at this time, though more so

than in the corresponding period of 1905, and with favourable weather in the coming weeks the return is likely to be fairly good. Oats and beans look good, but the season has been less favourable for peas. It is too early to pronounce a definite opinion as to the potato crop, but its progress has been retarded by cold and wet weather. Estimates as to roots can only be taken as preliminary, and as indicating the present position of a class of crops which makes its principal growth after midsummer. In the Eastern, North Eastern, South Eastern, and East Midlands prospects are equal with those of last year, and superior to those of 1905, but the position is less promising in the West Midlands, the North-West, and the North. It is rather surprising, having regard to the damp, cold weather, to find the reports as to hops so favourable. Kent gives an average prospect of 84 per cent. against 60·5 last year; Sussex shows an average of 83 per cent. against 64·5 last year; Hampshire 90 per cent. against 54 per cent. last year, and Worcestershire 77 per cent. against 54 per cent. in 19.6. The area under cultivation this year shows urther shrinkage.

Coal.—Usually, almost invariably, the demand for coal, more especially house coal, reaches its lowest ebb in the summer, but this year instead of prices being reduced they are actually being increased. A few days ago, that is to say in the early days of July, and on the London market, north country house coal was advanced 1s. per ton, following a previous advance of 6d., and a similar experience is reported from other parts of the country. In the Lothians for the first time, as it is said, in the history of the local house coal trade, there was on July 1 an increase of 1s. per ton in splint coal. If this is the state of things in midsummer, what is likely to be the condition of the market when summer ends. The unusually cold season has no doubt had an appreciable effect on the market, but it is the great and growing export demand that is mostly accountable for rise in prices. It is stated that the Westphalian Syndicate has already sold the whole of its production up to the end of 1908, and in consequence of the difficult position in which it finds itself owing to the great home demand, it has been compelled to abandon one foreign market after another, a fact which has a very direct bearing upon our export trade. Add the general improvement in the trade of the United Kingdom, and the increase in the wages of the miners, and we have the explanation of the present almost unprecedented high rates for coal. Any way the coal-owners, relieved of the export duty on coal, which in five years yielded the Treasury £11,000,000, and which, if this explanation is to be accepted, was paid by them, must be specially prosperous.

The Growth of Insurance.—In opening the new offices of the United Kingdom Temperance and General Provident Institution, the Chancellor of the Exchequer directed attention to the growth of the office during the fifty years of its existence. "I find," he said, "that fifty years ago the total annual income of your institute was only £40,000, while last year it amounted to nearly £900,000. At the earlier date the accumulated funds were £115,000; they are now over £8,500,000, and the amount insured has risen from £1,250,000 to £19,000,000. But these figures, remarkable as they are, are to some extent typical figures. At the present time the life insurances actually in force number, in what is called the ordinary offices, over 2,397,000, and in the industrial offices 25,000,000, a total of nearly 28,000,000. In its annual insurance tables just published the *Statist* shows that "in the short space of 20 years the annual sums devoted to life insurance have grown from £16,000,000 to nearly £37,000,000, an expansion of £20,000,000 a year, or 125 per cent.; while the growth during the last ten years has been nearly £12,000,000, or 46 per cent." Seeing that the population of the country has during the last twenty years increased at the rate of only about 1 per cent. per annum, the magnitude of an expansion of 125 per cent. in the sums applied to life assurance will be apparent. In 1887 the sum devoted to life assurance was slightly over 9s. per head of population. According to the latest returns it is now over 17s. per head. The following figures show the sums now paid for life and old age assurance as compared with the figures of 20 years ago:—

	Annual Premium Income. £	Per head of Population.
1887	16,396,960	·459
1907	36,952,296	·853
Increase 20 years +	20,555,336	+ ·396
Do. per cent. .. +	125 %	+ ·86 %

The interest on the funds now accumulated by the life offices is close upon £12,000,000, and the total income of the life offices from premiums and interest is nearly £49,000,000. In 1895 the accumulated funds of the life offices amounted to £213,000,000, and in 1905 they were £327,000,000, a growth in ten years of £114,000,000. Including the accumulated funds of fire, accident, and marine offices, the total assurance funds accumulated by insurance offices of all kinds grew from about £246,000,000 in 1895 to £376,000,000 at the end of 1905, an increase in ten years of £130,000,000, or 53 per cent.

OBITUARY.

SIR WILLIAM PERKIN, F.R.S.—By the death on Sunday, 14th inst., of Sir William Henry Perkin, LL.D., Ph.D., D.Sc., founder of the Coal Tar Industry, the Society of Arts has lost a distinguished member. He was elected a member in 1868, a member of the Council from 1877 to 1879, and a Vice-President from 1880-1882. In 1890 he was

awarded the Albert Medal "for his discovery of the method of obtaining colouring matter from coal tar, a discovery which led to the establishment of a new and important industry, and to the utilisation of large quantities of previously worthless material." It was only last year that the fiftieth anniversary of his discovery of the dye stuff "mauve" was publicly celebrated and a knighthood was conferred upon the discoverer. An account of the proceedings of this important celebration will be found in the *Journal* (vol. 54, p. 901).

Sir W. Perkin was born on 12th March, 1838. He received his early education at the City of London school, but left school in his 15th year to enter the Royal College of Chemistry, then under the superintendence of Professor Hofmann. Here he became Hofmann's private assistant in the research laboratory. In 1856, in the course of attempts to prepare quinine artificially, he was led to oxidise aniline, and obtained as a product the colouring matter, which afterwards became known as aniline purple or mauve. He determined to undertake the manufacture of the dye (which was patented in August, 1856), and in June, 1857, aided by his father and brother, Perkin began building works at Greenford Green, near Harrow, where the manufacture was carried on successfully during many years.

In 1859 the Société Industrielle of Mulhouse awarded Mr. Perkin a silver medal and afterwards a gold medal for his discoveries.

In 1868, when Graebe and Liebermann announced their discovery of a laboratory method of preparing madder-red or alizarin, Perkin devoted himself to searching for new processes by which the discovery could be made practically valuable. He succeeded in his endeavours, and alizarin was first manufactured commercially at Greenford Green in 1869. Besides these two great works, Sir William Perkin made many other discoveries, and contributed a large number of original papers to the Journal of the Chemical Society. He was elected a Fellow of the Royal Society in 1866, and in 1879 he received the Society's Royal Medal for his researches in organic chemistry, and ten years later the Davy Medal. Sir William Perkin delivered in December, 1868, three lectures before the Society of Arts on the Aniline, or Coal Tar Colours, and in May, 1879, two lectures before the Chemical Section on "The History of Alizarin and Allied Colouring Matters, and their production from Coal Tar."

GENERAL NOTES.

PETROLEUM IN ROUMANIA.—The petroleum industry is becoming a very important one in Roumania. The total production in 1906 was 887,091 tons, an increase of about 45 per cent. over that of 1905, and Roumania now produces more petroleum than any other country save he United States, Russia, and the Dutch Indies. Roumania is very favourably situated geographically, and the new sources of supply which are constantly being discovered seem to give justification for the belief that she may gradually gain a dominant position in this article, in which she is already unrivalled from the point of view of quality. Reporting on the trade of Roumania for 1906 Mr. Consul Wardrop (Cd. 3283) says that experiments made by the Service Maritime Roumania have shown that on every trip made by their steamers there is a saving of more than £40 due to the use of this fuel, besides the additional advantages of cleanliness, saving of space, and fewer hands. The Roumanian naval and mercantile fleet is the only one which exclusively uses petroleum fuel. It checks the destruction of the forests, saves large expenditure on foreign coal, guarantees fuel in case of war, lessens the dependence of the country on grain export alone for its prosperity, gives wealth to the people, taxes to the State, and traffic to the railways.

SANTO DOMINGO.—Mr. Vice-Consul Rowley's report on the trade and commerce of Santo Domingo, better known by its old carib name of Haiti (highland), is melancholy reading. The black Republic makes little or no progress. In 1903 it was bankrupt, and found itself compelled to suspend payment of the interest on its foreign loans and debts; the foreign debt amounting to about £6,185,000, and the internal debt to about £2,061,855, and although the convention with the United States, drawn up in February last, will improve the financial position, the trade and commerce of the Republic show few signs of expansion. Santo Domingo is, practically speaking, destitute of even the ordinary waggon road, the horse or cattle tracks being the only means of communication between the towns, villages, and sea ports. The majority of the people, says Mr. Vice-Consul Rowley (Cd. 3283), are most indolent, and cultivate barely sufficient ground to raise the necessary cereals for their own use, the markets in the various towns are meagrely supplied with even the most necessary vegetables, and as nothing worth mentioning is manufactured, or made locally, everything has to be imported. The customs duties on all articles are exceedingly high, and many pay as much as 300 per cent. There are no sanitary or water systems in the capital, the former consisting of the ordinary cesspool, and the latter of the usual open well fed from the water collected off the roofs of the houses. Although the rainfall is enormous the people suffer greatly from want of water during a drought of a few days, and in March last the Vice-Consul says the people at Sanchez were buying water at the rate of ninepence a demijohn. The people are too lazy to build cisterns, and the barrels they use being open to the air offer an inviting breeding ground for innumerable mosquitoes, as well as dust, dirt, and disease germs.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

PRACTICAL EXAMINATIONS IN MUSIC.

The practical examinations in Music were not concluded this year until the 10th July, too late for the results to be included in the Report of the Council. They lasted for 12 days

The examination was conducted by Dr. Ernest Walker, M.A., and Mr. Burnham Horner.

The system of examination was the same as that for recent years. For instrumental music certain standards are given, and candidates are asked to select for themselves which of these standards they choose to be examined in. The standards range from easy to very difficult music. For each standard a list of music is given for study, and from this list candidates select the pieces they will sing or play. Candidates are expected to play or sing the pieces which they have prepared, to play or sing a piece, or portion of a piece, at sight, and to play certain scales.

In all, 466 candidates entered, and of these 457 were examined, a decrease of 10 as compared with last year. There were 371 passes and 86 failures.

The following were the subjects taken up :— Piano, singing, violin, violoncello, viola, and bassoon. 371 entered for the piano, 292 of whom passed ; 67 entered for the violin, of whom 61 passed ; 5 entered for the violoncello, of whom 4 passed ; 12 entered for singing, all of whom passed ; one entered and passed for the viola, and one for the bassoon. One medal was awarded.

The examiners report that—

" Some of the candidates were, perhaps, not wisely advised in entering for a standard too high for their present attainments. A few pianists chose items from the lists issued in 1906, and others were not fully equipped for the reading test at first sight. This latter qualification needs to be better observed by vocalists, as well as by those who enter for other subjects. Tone and touch have somewhat improved, but there are many cases in which very little attention is given to phrasing."

STOCK PRIZE.

FOR THE DECORATION OF PART OF THE INTERIOR OF A BUILDING.

The Council of the Society of Arts are prepared to offer, under the terms of the Stock Trust, a Gold Medal, or a Prize of £20, for

The Prize is offered for the best original designs for an Architectural Decoration, to be carried out in painting, stucco, carving, mosaic, or any other process.

This Architectural Decoration is to be for the side of a room or a hall, a ceiling, the apse or side of the chancel of a church, or any suitable part of the interior of a building.

The designs must be on imperial sheets. Each set must consist at least of a coloured drawing to scale of the whole design of decoration, and two coloured drawings of details on separate imperial sheets. Mere patterns or sketches of details, without the mouldings or borders necessary to make up a complete decorative scheme, will not be taken into consideration. The designs must have been made between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1893 or 1897 cannot compete again.

The designs are to be submitted, with other school work, in the usual manner, to the Board of Education, South Kensington, in April, 1908. Each of the imperial sheets, forming a set of competing designs, must be marked, " In competition for the Stock Prize," in addition to being labelled or staged according to the Regulations of the Board of Education.

THE SAND-COUNTER OF ARCHIMEDES: A FAMOUS FRAGMENT OF SCIENTIFIC HISTORY.

By T. E. Young, B.A., F.R.A.S.
(Late President of the Institute of Actuaries).

Separated by an interval of 1,850 years, the two most memorable names in the history of mathematical science are those of Newton and Archimedes. Adopting a form of illustration which Professor Tyndall applied in comparing Newton with Dr. Thomas Young (of "Undulatory" and "Hieroglyphic" fame), and employing the scale of native mathematical force, it may reasonably be stated that, supposing Archimedes and Newton to stand erect, each in his own age, a straight line drawn from the former to the latter, and tangent to the heads of both, would exhibit a very gently ascending gradient only, as the measure of their comparative intellectual stature. Alike in swiftness and sureness of intuition, in massiveness of mental concentration, and in virtually unerring grasp of mathematical relations, they reveal the rare heights of geometrical power, which the human brain in its finest moulding is competent to reach.

In science, where every region displays an impressive advance, the difficulty is extreme of equitably assessing the mental value of a past worker and the novelty and importance of his productions in the scale of intellectual accomplishment: the imposing mass of existing knowledge tends to dwarf his contribution to the store; and it demands a strain of detachment from the present and the exercise of the dramatic power of translation into other times and ranges of thought before a valid judgment can be framed. It becomes imperative, as a rule of measurement, to attempt the construction of the ratio of his achievements to the extent of knowledge and capacity in his era. On this ground it is proposed to preface an exposition of the scheme of numeration which Archimedes devised, and the concrete problem upon which he tested its capability, with a brief outline of the condition of arithmetic at his date—his treatise having been composed somewhat earlier than the year 215 B.C. As Dr. George Peacock—the most learned of the historians of arithmetic—has pointed out, it is hardly possible to describe that condition with punctual certainty, since changes of notation occurred whose approximate dates of introduction cannot be ascertained; but, at all events, the following sketch exhibits the utmost extent to which the Greek arithmetical system could have, or had, attained. The symbolic expression, by the letters of the alphabet, of the 9 digits, the 9 tens, and the 9 hundreds, required the employment of 27 letters; the Greek alphabet containing 24, two obsolete letters were revived for 6 and 90 respectively, and as the representation of 900 a symbol was borrowed from the Phoenician alphabet. Thus, the first 9 letters symbolised 1 to 9 successively, the next 9 expressed the tens from 10 to 90, and the remaining 9 represented the hundreds from 100 to 900. The indication of thousands was effected by suffixing an iota (ι) to the letters which marked the 9 digits; thus δ being expressive of 4, δ_ι denoted 4,000; and hence they obtained an additional set of numbers ranging from 1,000 (by increments of 1,000) to 9,000. Their arithmetical notation consequently was restricted, so far as the preceding symbols were serviceable, to the number 9999. In their language, however, they possessed a term—μυριάς (myriad)—for the succeeding unit of 10,000 without a corresponding literal symbol; and, in practice, they secured the advantage of this factor by subscribing the letter M or postscribing the letters Mυ to the alphabetic symbols for any of the numbers included in the scheme. Thus θ, which expresses 9, was converted into 90,000 (or 10 thousand-fold) by writing it $\overset{\theta}{\mathrm{M}}$ or θ Mυ. Hence they reached a final limit of 8 places of figures or 9999 9999. Intermediate numbers, such as 11, were indicated as the sum of 1 and 10; as ι represented 10, and α, 1, their sum or 11 was symbolised by $\iota\alpha$. This practice does not imply a recognition of our modern principle of local value, for each of the alphabetic characters always retained its definite numerical value, and consequently the order of $\iota\alpha$ or $\alpha\iota$ did not affect the result as in modern notation. In actual arithmetical operations, however, the Greek was virtually confined to the myriad, and any vast number was regarded as beyond the range of numeration, or was deemed to be coincident with infinity. In their current modes of calculation the case of multiplication may be cited. The operation was conducted from left to right; each product was recorded separately without incorporation with those which preceded or followed, and in any order or without order; and the several products were then collected and added into a total sum. Where the results of the multiplication of numbers were not contained in the simple

multiplication-table (committed to memory) they were, as a rule, generally obtained, not by the Abacus, but by the cumbrous process of repeated additions. A remarkable novelty in multiplication will appear in the explanation of the method of Archimedes.

The title of the work of Archimedes is Ψαμμίτης (= sand), but it is usually described as the Ārēnārĭus, or sand-reckoner (ărēna = sand), or the De Numero Arenae. He had published a prior work upon the principles of Numeration (entitled 'Αρχαί), which has been lost; the scheme there proposed is, happily, repeated in its essential features in the present book,—Archimedes stating that this course would be convenient to those who had not had the opportunity of perusing his previous monograph. The terms expressive of the values of numbers up to a myriad having been delivered from tradition, Archimedes remarks that a continuation of the process will produce the myriad of myriads (or 100,000,000); he then proposes to extend this method in a form adapted to avoid the confusion incidental to vast numbers so that the highest assignable numbers might possess the facility of expression and use which attached to the simpler numbers. For readiness of understanding, I shall employ ciphers, instead of letters, throughout, although the zero (of Indian origin) was not introduced until about 600 or 700 years subsequently; it is the comprehensive *method* of Archimedes that concerns us.

(α). A series of consecutive numbers is formed, starting from 1 as its unit; this unit is multiplied successively by 10, 100, up to 10,000,000 (or 1000 myriads); 8 terms are thus obtained, and the collection is designated the 1st degree of myriads; each term possesses its name: the 1st of the degree is the unit, the 2nd is the tens, the 3rd the hundreds, the 4th the thousands, the 5th the myriads, the 6th, tens of myriads and so on. This mode of description applies to every degree of myriads; and each degree is generally termed an octade as consisting of 8 terms.

(β). The 8th or final term of the 1st degree is multiplied by 10, and the product constitutes the unit (or, as it is sometimes named, the monad) of the 2nd degree of myriads, or 100,000,000. A 2nd octade is thus started with this unit. Multiplying such unit, as before, by 10, we obtain the 2nd term of the 2nd degree, or the tens of that degree: the multiplication of the unit by 100 (making 10,000,000,000) produces the 3rd term or the hundreds of the 2nd degree; and the final multiplication of the unit by 10,000,000, *i.e.*, by thousands of myriads (as was done for the corresponding term in the 1st degree), furnishes the 8th term of the 2nd degree or 1 followed by 15 cyphers. Thus 8 additional terms are constructed, and in the last term of this degree we have reached the 16th term in the consecutive series. The 8 terms here formed compose the 2nd degree of myriads or the 2nd octade. (It is proposed hereafter, where the numbers largely increase and the plan is feasible, to adopt, for brevity, the convention invented for the expression of ciphers by the mathematician, Benjamin Gompertz, who employed a circle with the number of ciphers inscribed—thus 1,000,000 is symbolised by 1 (6); on my mentioning this artifice to the late Mr. Gladstone, with which he was greatly pleased, he communicated to me a somewhat similar device of his own for aiding his remembrance of extensive round figures in his Budget speeches).

(γ) The 3rd degree of myriads is constructed in the same manner. The 1st term or unit consists of 10 times the 8th term of the 2nd degree, and is 1 (16): multiplying this unit successively, as before, the final or 8th term of this particular degree is produced, or 1 (23),—thus bringing us to the 24th consecutive term of the entire series, and the conclusion of the 3rd octade.

The last term of any degree, it will be noticed, is formed by the multiplication of the unit of that degree by 1,000 myriads.

(δ) The process is continued, degree by degree, up to the degree which Archimedes designates the myriomyresimal degree of myriads, *i.e.*, the (myriad of myriad)th degree or the (100,000,000)th degree. It is needless to describe the intermediate steps—the 4th, 5th, and sequent degrees—as the uniform mode of formation is sufficiently clear, or to calculate the values of the several 8 terms which constitute this final or myriomyresimal degree. We can at once express any term required, and any term of any degree, by following the method of construction. Thus, we may directly ascertain the unit and the 8th term of this ultimate degree. The unit of the 1st degree consists of one figure; the unit of the 2nd of 9; that of the 3rd of 17, and so on: hence the number of figures constituting the units compose an arithmetical progression whose common difference is 8. Employing, then, the usual formula for the last term of such a progression, we obtain for the unit of

the myriomyresimal degree (the number of degrees up to, and including, this stage being a myriad of myriads) $1 + (100,000,000 - 1) \times 8$ or 799999993; or the unit or monad of the myriomyresimal degree is a number which can only be expressed by 799999993 figures, *i.e.*, 1 followed by 799999992 ciphers. For the 8th, or last, term of this degree, we observe throughout that the number of figures in the final term of any degree is obtained by multiplying the number of the degree by 8; hence, the last term of the myriomyresimal degree is 100,000,000 (the number of the degree) multiplied by 8, or consists of unity with 799999999 ciphers annexed. It is also obvious that, in any degree, the number of figures comprised in its last term is found by adding seven figures to its unit or by adding eight figures to the number of figures in the 8th term of the preceding degree.

(ϵ). It may be added that the unit of any degree is otherwise termed "myriad of myriads" of the preceding degree: *e.g.*, the unit of the 2nd degree is 100,000,000, and this is the unit of the 1st degree (or 1) multiplied by a myriad of myriads (or 100,000,000).

(ζ). The 5th term of any degree, it may be repeated, is also named "myriads" of that degree, since it results from the multiplication of the unit of that degree by a myriad. And the final or 8th term of any degree is designated "thousands of myriads" of that degree for a similar reason. These and other features are noticeable on inspection.

(η). Archimedes then remarks that the stage of numeration attained in the construction of the myriomyresimal degree affords numbers sufficiently ample for the solution of the problem of sand-counting; but, to display the power of the method, he advances to a further extension.

(θ). Designating the whole of the numbers comprised within the myriomyresimal degree as the 1st period, he proceeds by successive 10-fold multiplication in the same mode to higher classes. Thus, multiplying the number in the final term of the myriomyresimal degree by 10, he obtains the unit of the 1st degree of the second period, consisting again of 8 terms. Pursuing this continuous multiplication, and retaining the plan of octades, he forms the 8 terms of the 2nd degree of the 2nd period; and, finally the myriomyresimal degree of that period. The 8th term in that myriomyresimal degree being multiplied by 10 furnishes the unit of the 1st degree of the 3rd period, and thus the myriomyresimal degree of that period is finally attained. Similarly for the myriomyresimal degree of the 4th and subsequent periods. And, ultimately, where his process terminates, he reaches the myriomyresimal degree of the myriomyresimal period, the unit of which is a number composed of 79999 9999 9999 9993 figures, or 1 followed by that number, less 1, of cyphers; while the 8th, or concluding, term of this vast period consists of eighty thousand million of millions of figures or unity with a number of ciphers annexed equal to the number just expressed less 1. The reader should bear in mind that these numbers—and the remark applies to some other numerical expressions—are not numbers proper but the number of the places of figures which constitute the stated numbers. The preceding number being the final term in the myriomyresimal series, which starts with the 8th term of the 1st period, its value can be directly computed by the usual formula applicable to an arithmetical progression; but a little consideration of the structure of the scheme will show that it is obtainable at once by multiplying the last term of the 1st period by a myriad of myriads.

Although Archimedes concludes his system at this stage, it is obvious that the process is capable of indefinite expansion. For the whole of the numbers (following his own device) included in the scheme as terminated by him may be symmetrically regarded as a fresh point of departure, and be called (say) the 1st era, with additional vast stages of similar construction.

The analogy of this principle of formation with our existing methods should be noted. The 1st degree of myriads ends with 1,000 myriads; our 1st degree of thousands terminates with 1,000 thousands, or a million; the 2nd degree of myriads is completed by 1 15, or 1,000 myriads of myriads of myriads; our 2nd degree of thousands ends with a billion, or 1,000 thousands of thousands of thousands; the 3rd degree of myriads concludes with a number which is 1,000 of myriads of myriads of myriads of myriads of myriads; while our trillion, or 3rd degree of thousands, is composed of 1,000 thousands of thousands of thousands of thousands of thousands, and so on: precisely, therefore, corresponding to the scheme of Archimedes.

A very striking plan is deduced (anticipating, though unconsciously, the principle involved in the construction of logarithms) for determining the position in the series of the product of any two stated terms. If any two terms (we might

more properly say, numbers) be multiplied together, the place in the series of their product will be furnished by the sum of the distances of the two terms from unity (*i.e.*, from the 1st term of the entire series) diminished by 1. Thus, if from the series of numbers on a former page the two terms selected be the 3rd from unity (*i.e.*, the third term of the 1st degree) and the 12th from unity (*i.e*, the 4th of the 2nd degree) the product of the numbers appertaining to these terms (namely, 1 (2) and 1 (11)) is 1 (13). The respective distances from unity of the two terms (counting in, as Archimedes does, the 1st term or unity) are 3 and 12; consequently, the place in the series of the product is furnished by $3 + 12 - 1 = 14$. And a reference to the figures, already presented, shows that the number 1 (13), *i.e.*, 1 with 13 ciphers annexed, does occupy the 14th place. It is obvious that unity must be deducted from the sum of the distances, or—since the distances of the two terms necessarily overlap—a unit of distance (or a term) would be reckoned in twice. This is evident if we compute the distance from unity of the later term as the sum of the distances of the earlier term from unity, and of the later term from the (inclusive) place of the earlier one.

He also points out that the different denominations by which numbers are distinguished from each other exactly correspond, by the method of construction, to the several 8th places from unity. His exposition is not very clear, and the following explanation may be substituted. Let any term be stated, or let the number of figures appertaining to any term be given; the number of figures, then, in any number being identical with the consecutive number of its term, we may deal with either the term itself or the number of figures in the number. Divide the term (or number of figures) by 8, the characteristic element; if the quotient contain an integer only, the degree to which the term or number belongs is that particular degree indicated by the integer, and the 8th term of that degree is designated. If the quotient contain a remainder besides the integer, the integer specifies the number of the degree from which we are to reckon onwards to the extent shown by the remainder, when we shall reach the relevant degree and its term. Take the 16th term, or the number composed of 16 figures; the quotient is 2, and as there is no remainder the place of the term or number in question is the 8th term of the 2nd degree. Take the 13th term, or a number of 13 figures; the quotient of 1 with a remainder of 5 points to 5 terms beyond the end of the 1st degree (shown by the integer), or the 5th term of the 2nd degree. The application of the scheme to the concrete problem is now to be described.

1. A sphere of the size of a poppy-seed cannot contain, it is assumed, more than a myriad (10,000) particles of sand, and its diameter is not less than one-fortieth (or ·025) of an inch. Archimedes found, by trial, that the actual diameter was nearer ·04 of an inch, but he adopts an exaggerated fraction as a severer test of his system. Archimedes was aware that the contents of spheres are to each other as the cubes of their diameters; hence the proportion—the sphere of a poppy-seed: a sphere of 1 inch diameter : : the cube of ·025 : the cube of 1,—furnishes the volume of a sphere of 1 inch in diameter, which is the volume of the smaller sphere multiplied by 64,000. But the volume of the smaller sphere is measured, by supposition, by its containing not more than 10,000 particles; hence the larger sphere will contain a number of particles less than $10{,}000 \times 64{,}000$ or 640 millions: this number consists of $600{,}000{,}000 + 40{,}000{,}000$, or (referring to the scale already partially presented) 6 units of the 2nd degree and 4,000 myriads of the 1st degree. This is clearly less than 10 units of the second degree, whose unit multiplied by 10 gives 1,000 millions. A similar process furnishes the superior limit of the number of particles in successively larger spheres until the sphere of the earth is reached.

2. The earth's circumference was estimated by the scientific contemporaries of Archimedes to be nearly 300,000 stadia. A fair average value of the στάδιον (the measures of the authorities on classical antiquities differing) may be accepted as 600 English feet, so that this estimate was about 10,000 miles in excess of the true value. For the same purpose of demonstrating the practical extent of his numerical system, Archimedes accepts a circumference of 10 times the current value or about 3 million stadia. He had himself, by a geometrical process, ascertained that the ratio of the circumference of a circle to its diameter (or π) was greater than 3 and 1/7 and less than 3 and 10/71—a remarkably close approximation—and hence was able to calculate the earth's diameter from this exaggerated circumference, placing it at less than one million stadia (about 14 times its computed real value). Summarising the pro-

cess of Archimedes, we can determine the volume of the earth from that of the sphere of one inch by the ratio of the cubes of the diameters. Hence, the volumes being measured by the numbers of included particles of sand, the appropriate proportional sum expresses that the number of particles capable of being contained in a sphere of the earth's size and completely filling it will be the number of particles contained in the sphere of one inch (the inch being about ·00014 of a stadion) multiplied by the cube of the earth's assumed diameter. Working this out in detail, I find that the required number of particles can only be expressed by a number comprising 39 figures. Archimedes simply states that the number is less than 1,000 myriads of the 5th degree. The two results coincide: thus, the 8th term of the 4th degree has $4 \times 8 = 32$ figures; the next term, or the unit of the 5th degree, has 33, the 2nd term has 34 ..... and the 5th term (or myriads) of that degree has 37 figures, and the multiplication of that number by the 1,000 gives 40 figures, or a number in excess of ths calculated value. Thus, the number of particles possible of inclusion within the entire volume of the earth is measured by a number which appears in a very early stage of the series of Archimedes.

4. What number of particles, then, could be included within the sphere of the world or κόσμος? Scientific opinion (including that of Archimedes) regarded the earth as the centre of the world, and the radius of the world's sphere or of the cosmical universe was measured by the distance between the sun and the earth. A fact is here worthy of record as indicating the probable fate of many a memorable deduction of genius. The astronomer Aristarchus (who was contemporary with Archimedes) entertained the view that the sun was immoveable as the centre of the universe, round which the earth annually revolved. The sphere of this universe was hence conceived by Aristarchus to be immeasureably more vast than the limited expanse which the current astronomical doctrine defined. Thus, Aristarchus anticipated the conception of the true cosmical system by 1800 years, and yet, had not this incidental allusion been preserved in the treatise of Archimedes, that remarkable reach of scientific vision which renders the name of Aristarchus illustrious would (so far as authentic evidence is concerned) have remained unknown. Archimedes rejected the teaching of Aristarchus upon the spaciousness of the universe, but included it in his calculations simply with the object of displaying the ample scope of his numerical scheme. The mathematical form in which, it appears, Aristarchus had embodied his conception was repugnant to the severe geometrical taste of Archimedes, and he accordingly interprets the Aristarchian doctrine to mean that the ratio of the earth to the sphere of the κόσμος (as customarily understood) was the same as the ratio of the latter to the enlarged sphere of Aristarchus. But first he considers the number of sand-particles which the accepted sphere of the world was competent to contain. This number he ascertains to be less than 1,000 of the 7th degree of myriads. We can confirm this by the adoption of the four proportionals expressed by the volume of the earth, the volume of the sphere of the world, and the cubes of the diameters of these spheres. By an ingenious course of geometrical reasoning (founded upon the data then available) Archimedes deduced that the diameter of the sphere of the world was less than 10,000 times the earth's diameter. Hence we obtain our proportion: as the number of particles which the earth can contain is to the number capable of being comprised within the sphere of the world, so is the cube of the earth's diameter to the cube of the diameter of the world's sphere. The calculation shows that the multitude of particles which the world's sphere could include requires for its expression a number less than a number consisting of 52 figures. This agrees with the preceding assertion of Archimedes. For the 8th term of the 6th degree of myriads contains, as can be readily computed, 48 figures; and proceeding to the thousands of the 7th degree (or 4 figures more) we obtain 52.

5. Archimedes then proceeds with the same enquiry relating to the extended sphere of the universe of Aristarchus. He first determines the diameter of this sphere to be less than a myriad times the diameter of the world's sphere on the current hypothesis: it is, however, sufficient to adopt the following proportion: the volumes of spheres being related to each other in the triplicate ratio of their diameters, and these volumes being measured by the number of sands which the spheres are capable of comprehending, we obtain the proportionals,—the number of sands contained in the earth is to the number comprised within the sphere of the world as the latter number is to the number we are seeking for the Aristarchian κόσμος. This works out, by my calcu-

lations, at a number less than a number comprising 64 figures, or 1 with 63 ciphers attached. Archimedes summarily assesses the number at less than 1,000 myriads of the 8th degree. Now, the last term of the 7th degree contains $7 \times 8 = 56$ figures; and counting onwards through the unit, tens, ... to the myriads of the 8th degree we arrive at a number consisting of 61 figures; multiplying this by the 1,000 (to obtain the 1,000 myriads) we reach a number constituted by 64 figures, which shows the coincidence of the two calculated results. That is to say, the multitude of particles of sand which could be included within the compass of the Aristarchian universe may be expressed by a number less than 10 raised to the 63rd power. A number, therefore, which the scientific and ordinary mind of that age regarded as impossible of numerical expression, is comprised within the 8th degree only of the vast system of Archimedes. As the number of any term in this continuous series is identical with the number of figures in the number attached to that term, the number in question constitutes only the 64th term in the series from unity.

Reference may here be made to a calculation contained in the "Principles of Science" of the late Professor Jevons. He takes the number 2; 2 raised to the 1st power (= 2) he terms the 1st order; 2 squared or 4 is the 2nd order; 2 to the 4th power or 16 constitutes the 3rd order; 2 raised to the 16th power forms the 4th order. Now, 2 to the power of 16 is 65536, and we thus ascend at one step from a stage of 16 to one of 65536; but advance one further step to the 5th order, or 2 raised to the power of 65536, and the result can only be expressed by a number consisting of 19729 figures. Now the distance of the remotest telescopic stars from the earth is about 33,900 million million miles. Lord Kelvin has calculated that a cubic centimetre of a liquid or solid substance does not contain more than 3×10^{24} to 10^{26} molecules—the molecule of ordinary matter possessing a diameter from one ten-millionth to one one-hundred-millionth of a centimetre; hence this stupendous sphere of the stellar universe—a sphere measured by a radius of 33,900 billion miles —would not comprise, if completely filled with solid matter, more molecules in number than about 68×10^{90} or a number for whose expression 92 places of figures would be required —a number immensely inferior to the 5th order of the powers of 2. By independent calculation and using the formula for the volume of a sphere, I have exactly verified this result. We can readily ascertain that this number would form the 4th term of the 12th degree of Archimedes. (The diameter of the molecule, just mentioned—taking the mean value—is equivalent, when expressed in British measure, to 1/137,500,000 of an inch. Archimedes does not specify the diameter of his particle of sand, but it may be approximately calculated. If x be the volume of a particle, then $10000\,x$ is to be equated to the volume of a sphere of one-fortieth of an inch in diameter. From the value of x thence deduced, its diameter can be ascertained by the usual formula, and the diameter of a particle of sand in the problem of Archimedes is thus found to be 1/862 of an inch. It may also be mentioned that the radius of the Aristarchian sphere adopted by Archimedes comprises 6 billion miles compared with the preceding figure for the stellar universe.)

It forms an impressive coincidence—though, as Dr. Peacock has stated, justly, I think, a coincidence only—that the principles of this method and of the theory of logarithms are identical. It is worth while exhibiting this congruity in a brief form. I have prepared the following suggestive Table:—

Number of the term in the series.	The numbers of Archimedes.	Logarithms.
1	1	$10^0 = 1$
2	10	$10^1 = 10$
3	100	$10^2 = 100$
4	1,000	$10^3 = 1{,}000$
5	10,000	$10^4 = 10{,}000$
6	100,000	$10^5 = 100{,}000$

In the 3rd column, the index of the base of logarithms, 10, is termed the logarithm of the number on the right-hand side of the equation, so that $10^2 = 100$ expresses that 2 is the logarithm of 100 to the base of 10; and it will be observed that the logarithms increase in arithmetical progression while the corresponding numbers increase in geometrical progression. Hence we perceive:—

(1) That the numbers to which the base (raised to the several powers) is equated coincide with the numbers of Archimedes in the same terms; or, thus expressed: just as the logarithms proceed in arithmetical progression and the numbers of which they are the logarithms in geometrical progression, so, in the scheme of Archimedes, the terms advance in arithmetical progression and the numbers

attached to those terms in geometrical progression.

(2). If we desire to find the product of the numbers in (*e.g.*) the 2nd term and the 4th term, we add the logarithms in those terms, *i.e.*, the indices; thus, $1 + 3 = 4$, and 4 is the logarithm of the product or the 5th term, and the number corresponding to this logarithm is seen to be 10,000, which is the product of the number in the 2nd term (or 10) and the number in the 4th term (or 1,000). Similarly Archimedes adopts the course of finding the same product; the distances of the terms, 2 and 4, from the unit or 1st term are 2 and 4; their sum is 6; deducting 1 we obtain the place or term of their product, namely, the 5th, or 10^4, *i.e.*, $10 \times 1{,}000 = 10{,}000$, as before.

(3). It is needless to enlarge (in contrast with the cumbrous and intractable nature of the traditional Greek notation) upon the facility in computation and in the reference of numbers to their appropriate places in the series which was introduced by the methodisation of his scheme in sets of octades as a fundamental property of his numeration. By adopting this artifice it will be observed that the units or 1st terms of the several degrees are really the base of 10 raised to the successive powers of 8 in arithmetical progression; thus, the unit of the 2nd octade is 10^8, that of the 3rd, 10^{16}, and so on.

The coincidence is remarkable. But, in all probability, neither the extent nor the character of mathematical knowledge existing in the age of Archimedes, nor the nature of the question which he discussed, could suggest the definite establishment of the formal system of logarithms with their fundamental property that the sum of any two logarithms should be equal to the logarithm of the product of the numbers to which those logarithms corresponded. The immortal invention of Napier, accordingly, would appear to remain unchallengeable; and this is not the first occasion in the history of inventive thought on which a sagacious discoverer has verged closely upon the detection of an illuminating principle which has profoundly modified the entire condition of scientific work.

The mathematician, M. Chasles, in a paper contributed, in 1842, to the French Academy of Sciences, presented an excellent summary of the modes of admiration which scientific men had expressed, in modern times, of the ingenuity and value of this treatise; the arithmetician discovering in the method an analogy with the modern principle of the value of local position in numeration; the algebraist extracting from it the principle which lies at the foundation of the theory of logarithms; the geometrician extolling the geometrical processes which Archimedes devised and pursued in the course of his enquiry; and the astronomer dilating upon the admirable manner in which Archimedes had conducted the geometrical investigation for the determination of the distance of the sun. But one main object of M. Chasles' exposition is the proof that the treatise was not intended to simplify and expand the numeration of the Greeks; that the principles of numeration were only introduced incidentally, and that the essential purport of the book was the philosophical and mathematical one of destroying an immemorial error with respect to the impossibility of assigning by numbers a superior limit to the multitude of grains of sand which the earth could contain. A critical analysis of the tract clearly demonstrates, I consider, that this judgment of M. Chasles is erroneous, and that it is even constructively contradicted by the form of the book itself and by certain expressions which Archimedes employs. The principles of his system of numbers were expounded by him in a prior treatise, which is not now extant, and which (inferentially) was unaccompanied by any practical application. If Archimedes had designed to subvert, as his main purpose, an ancient error respecting the numeration of sands, the concrete illustration would surely have found its appropriate place in the first tract as an admirable example and commendation of the power of his method. This illustration very evidently did not appear in that work, for Archimedes, in quoting from the monograph, never refers to the sand question as having been there discussed; and, moreover, it would have been an irrational surplusage of authorship to issue two treatises upon one identical problem. At the commencement of the present book, Archimedes states that the magnitude of the number of sands in Syracuse, and in the rest of Sicily, was regarded as innumerable; much more so, then, would it be maintained that no system of numbers could be discovered to express the multitude of grains in the entire world. This evidently shows that an objection had been raised to the scheme of his former work on the practical ground of its general incapability of application to actual cases. He affirms that he can prove geometrically that the terms for numbers which he had formerly proposed were competent to afford a complete answer to the problem

and also to a much wider one submitted by himself. He then repeats an abstract of the numerical processes from the earlier book, and applies them to the refutation of the popular belief in the impossibility of numbers being invented for the solution of the concrete problem even in its limited shape. Hence, the primary object of the treatise was not the exposure of an ancient error, but the re-affirmation of the principles he had already enounced *by means* of their application to a specified case. The solution of a problem of this minor importance would not, as a mere problem, have been worthy of the devotion of the consummate geometrical power of a mathematician like Archimedes, but the problem was highly worthy of investigation as a mode of confirming and practically exhibiting the general applicability and range of the method which he had already submitted to the scientific world.

THE GOVERNMENT PATENT BILL.

The following letter was printed in *The Times* of 19th inst.: —

"SIR,—The Patents and Designs Bill (as amended by Standing Committee C) contains the following clause: —

"7. The following proviso shall be added to subsection (6) of section 1 of the Patents Act, 1902: —

"'Provided that the Comptroller, if satisfied that the invention claimed has been wholly claimed or described in any specification to which the investigation has extended, may, in lieu of requiring references to be made in the applicant's specification as aforesaid, refuse to grant a patent.'

"Under subsection (6) of section 1 of the Patents Act, 1902, which was the outcome of careful inquiry and report by a strong Departmental Committee, including Sir Edward Fry (chairman), Lord Alverstone, and Lord Justice Fletcher Moulton, the Comptroller already has, and exercises, power to require specific reference to be made in the applicant's specification (by way of notice to the public) to any prior specification which in the Comptroller's opinion anticipates the invention claimed by the applicant.

"It is therefore quite impossible for an applicant to deceive the public as to the novelty of his invention, or to conceal from the public any alleged anticipation. If the invention be really anticipated, the applicant's specification will itself at once condemn his patent, and the grant can do no harm.

"But whether or not the invention described and claimed by an applicant is wholly anticipated is essentially a matter of opinion. Experience shows that a man looking at a publication some years old, when he has an invention before him, reads that publication in a very different spirit from that in which he would read it if he had not known of the invention then before him; and it is not an uncommon thing for an examining official to interpret as an anticipation that which is no real anticipation. In the High Court of Justice it requires the most profound judicial heads, often, to distinguish what is anticipation and what is not.

"Indeed, it may be affirmed that, in all cases where patents have been sustained for doubtful subject-matter, they have been sustained on the ground of great benefit or advantage having been found to result from the use of the invention. At the time of applying for a patent, however, it is often impossible to have evidence of such utility, and neither the Comptroller nor (in case of appeal) the Court can be expected to look into the future of an invention which at first b'ush may seem to have been anticipated.

"Even in countries where the strictest examination obtains, coupled with power of refusal for supposed anticipation, many invalid patents are granted.

"A patent that leads to commercial introduction of an article not previously on the market conduces to industrial activity and employment of workpeople, and therefore is advantageous to the community, even should the patent subsequently prove to be invalid. Moreover, the Bill contains ample provision for revocation of invalid patents.

"But a single error in judgment, resulting in refusal of a patent on the ground of supposed anticipation, may inflict irreparable injury upon the applicant, prevent profitable outlay of capital, rob many workpeople of employment, and deprive the community of the benefits the commercial introduction of the article would have conferred.

"The refusal of patents for supposed lack of novelty imparts a false hall-mark upon the many invalid patents that are nevertheless granted, and so misleads the public.

"The proposed practice would place those seeking British patents at a disadvantage as compared with those seeking patents in other important manufacturing countries, such as France, Belgium, and Switzerland, where applicants are allowed to take patents at their own risk, and the United States of America, where the inventor is allowed, without prejudice to his rights, to use his invention for a considerable time before applying for a patent, and, therefore, stands a better chance of differentiating his invention from alleged anticipations; and where, also, if the examiner regards the invention as anticipated, the applicant can appeal to the Board of Examiners-in-Chief, and from them to the Commissioner, and from him to the Supreme Court of the District of Columbia.

"Official records show that during the past 45 years the subject has been often considered by eminent men and influential technical bodies, who have repeatedly expressed the opinion that an adverse report should not disentitle an applicant to a patent.

"In these circumstances we regard clause 7 as most dangerous and undesirable in the public interest,

and we, therefore, hope that it will be eliminated before the Bill becomes law.

Your obedient servants,

WILLIAM CROOKES.	ALFRED GORDON SALAMON.
HORACE DARWIN.	JAMES SWINBURNE.
H. S. HELE-SHAW.	JOHN I. THORNYCROFT.
WILLIAM RAMSAY.	

London, July 18th."

CARPET-MAKING IN BOMBAY AND BENGAL.

Two monographs on carpet-weaving in India have recently appeared, one dealing with the Bombay Presidency, and the other with Bengal. As, however, the former is the more important work of the two, it claims prior mention. The author is Captain H. J. R. Twigg, Superintendent of the Central Prison at Hyderabad (Sind), where the work of carpet weaving is actively pursued. The object of the monograph is to give an account of this industrial art in the past, the conditions under which the craft now exists, the current methods of manufacture, the improvements, and probable future of the industry. Of course it will be understood that the term "carpet" must not be construed too rigidly, and the question "When is a carpet not a carpet?" is not very easy to answer. The old Persian carpets were often so delicate and light in texture that not even stockinged feet were allowed on them. Many of these articles were used as *portières* or wall or ceiling decorations, or were spread over cushions. In Sind, what is called the *farasi* is usually spread on the bed, while among the free population of the Western Presidency, the very few articles made after the fashion or method of carpets are used for rougher and altogether different purposes. Indeed, it may be said that outside the jails, woollen pile carpets are practically not made at all. The pile, it may be explained, consists of the upstanding ends of very numerous pieces of wool woven in by hand into an understructure, generally of cotton. Such is the ordinary *galicha*, or pile carpet. The other common form of carpet is the *dari*, which is generally of cotton, and presents a flat surface and an identical design on both sides. The pattern is obtained by passing under and over certain cotton threads variously coloured pieces of yarn, the ends of which are broken off and the tags tucked in neatly. The pile carpets appear to have originated at an early date in Egypt and Babylonia, whence the art of weaving then spread westward along Northern Africa into Sicily and Spain. Eastward again, the numerous changes of rulership in the lands grouped round Persia has resulted in a mingling of characteristics in which trade routes and military camps played an important part. The *galicha*, as regards India, has followed Mohammedan advance, but how the *dari* has arisen in or spread throughout India is not known. Nevertheless the *dari* is more typically Indian than the pile carpet.

One important fact noted by the author is that exhibitions have in recent times played a prominent part in encouraging carpet-making in India. The origin of this movement was of course the Great Exhibition of 1851, previous to which only the connoisseurs had any knowledge of Indian carpets. Unfortunately a demand for cheapness and rapid out-turn soon arose, and this was succeeded by a deplorable falling off in excellence. Half a century later, the Delhi Exhibition of 1903 had a wholly good effect on the Indian carpet trade, and brought home to purchasers the general excellence of Indian carpets. A large proportion of those visiting the exhibition were American, and as America does not reckon carpets among its own products, a brisk demand from the States ensued for such goods as were not jail made, the latter being excluded by American Customs law. Those that were exported came usually from Amritsar, Lahore, Agra, and Mirzapur, but in addition to these there are scattered up and down the whole of India surprisingly numerous institutions, partly commercial, partly industrial, partly missionary or scholastic, which all send carpets to America. At the same time it should be borne in mind that some of the prison-made carpets have had an excellent effect on the artistic development of the industry. Sir George Watt is of opinion that the Poona Jail has been the means of distributing some admirable carpets over Western India, while the Yeraoda Jail has helped to conserve designs and fabrics which might otherwise have been lost.

The present work contains some fifty plates, which give a very pleasing and serviceable notion of the designs in favour in various manufactures. It is difficult to describe these, but the author remarks that many of them are mainly Persian in conception. Persian rooms are often long and narrow, and generally devoid, as most Eastern rooms are, of furniture. The guests thus recline on cushions, leaving the centre of the field open for careful inspection. To represent in such an area a flower-strewn field, unbroken by any predominating figure, was the Persian's idea of luxury in house adornment. European rooms, studded with articles of furniture, invite bolder treatment as a rule, for it is few people who would care to follow the example of Lord Clive, who, in order to set off one of his carpets to the best advantage, designed and fitted a special room for its reception. The quality of the work can be ascertained by counting the number of stitches to the inch, and how to do this is a task of some complication, explained at length by the author.

On the whole, the general history of the carpet-making craft in the Bombay Presidency has been a period of decline with regard to both *daris* and *galichas*. As already remarked, the Great Exhibition of 1851 greatly stimulated the demand, but in Western India more particularly, there has been a subsequent

deterioration, mainly if not entirely through the strong demand for a cheap article. The author seems to make good the point that it is not the jails that have undersold free labour, for it is estimated that a Bhubak (Sind) carpet costing Rs. 18, if made in the Shikarpur (Sind) Jail would cost Rs. 42. There is an enormous demand from America, and probably one-half of it is for rugs about 7 feet by 4½ feet, at a price of about Rs. 40 (£2 13s. 4d.) apiece. The demand for such goods is almost unlimited. Of course there is plenty of competition from Asia Minor and Persia, to say nothing of centres within India itself, such as Amritsar, Lahore, Agra, and Mirzapore. Both the United Kingdom and Germany, too, send carpets to India in gradually increasing numbers, the German product being mostly of inferior quality. The only remedy that the author sees for this state of things in Western India is to try and start a wool-producing area in Bombay, where a *dari* factory and organised agencies for export would probably flourish. Persia and Kashmir exclude aniline dyes, but if this exclusion were practiced in India, the cultivation of other dyes would have to be extended.

In Bengal, according to Mr. N. G. Mukerji, Assistant Director of Agriculture, carpet-weaving is of very minor importance. The total number of operators, including the dependent members of families who subsist on it, is less than 5,000, by far the greater proportion of these being connected with the cotton-weaving industry. In this province the carpet-weaving establishments of jails might be looked upon in the light of schools, were it not for the fact that discharged prisoners never take to the industry, and the teaching is thus largely thrown away. They have not the capital to start on their own account, and it would be well if a company or association were formed to further their employment after their release. At Patna, where a readjustment of the art has been effected, the weavers are in a flourishing condition, but elsewhere most of the district reports are pessimistic in tone. Some practical suggestions for improvement are made by Mr. Mukerji, the chief of them being that establishments should be founded in important centres like Calcutta, Dacca, Darjeeling, &c. The Government would be well advised apparently in taking steps to encourage these recommendations.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department, Admiralty, in June, 1907:—

New charts.—No. 3635—Norway:—Skarholmen to Sörholm. 3618—British Columbia:—Moresby passage to Gabriola pass.

New plans and plans added.—No. 3138—Anchorages in south-east Alaska; plan added:—Redfish bay. 3145—Andaman islands:—Port Anson, &c.; plan added:—Elphinstone harbour. 895—Eastern archipelago; plans of anchorages in Bali, Lombok, &c.; new plan:—Chanjar road.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.

1607—England, east coast:—North Foreland to the Nore. 3191—England, east coast:—Woolwich to Erith. 2810—Ireland, east coast:—Lough Carlingford entrance. 122—Netherlands:—Mouths of the Maas. 3142—Netherlands:—Hook of Holland. 326—Denmark:—Great Belt. 2364—Germany, north coast:—Lubeck bay and Fehmarn belt. 449—Mediterranean sea. 689—Spain, south coast:—Gibraltar harbour. 1434—Adriatic:—Gulf of Trieste. 3119—Africa, north coast:—Alexandria harbour. 3301—Africa, north coast:—Tenez road and harbour. 2555—Africa, north coast:—Port of Algiers. 266—United States, east coast:—Great Egg harbour to Albemarle sound. 762—West India islands and Caribbean sea, sheet II. 2430—British Columbia:—Queen Charlotte islands and adjacent coasts of British Columbia. 2453—British Columbia:—Brown and Edye passages. 2563—Alaska:—Port McArthur to Windham bay. 2462—Alaska:—Windham bay to Icy cape. 2454—Phillippine islands:—Northern portion of the island of Luzon, &c. 1592—China, north-east coast:—Yung river and approaches. 624—Australia, south coast:—Hobson bay and river Yarra. 1512—New Zealand:—Anchorages on and off the north coast of North island. 2525—New Zealand:—North island, sheet I. 2460—Pacific ocean:—Kamchatka to Kadiak island, including Bering sea and strait.

These charts are issued by Mr. J. D. Potter, 145, Minories.

BAMBOO SAP.

The United States Consul-General at Calcutta says that the sap of the bamboo is used for medicinal purposes in India, and it may be had in the Indian bazaars at from one shilling and eightpence to five shillings and sixpence per pound, the latter being the specially white and calcined "tabasher." "Tabasher," or "banslochan," is sold in all Indian bazaars, as it has been known from the earliest times as a medicinal agent, its use as such having, it is supposed, originated among the aboriginal tribes. It is known in Borneo, and was an article of commerce with early Arab traders of the East. Its properties are said to be strengthening, tonic and cooling. A great deal has been written about "tabasher" in Hindu medical works which have been reviewed by modern writers. It has been analysed and has been shown to consist almost entirely of silica, with traces of lime and potash. With our present knowledge of medicine such an article is not calculated to be very efficacious, but from its remarkable occurrence in the hollow of bamboos the eastern mind has long associated it with miraculous powers.

HOME INDUSTRIES.

Motor Omnibuses.—It has been mentioned in these Notes more than once that it is still very doubtful whether, under present conditions, motor omnibuses can be run in the streets of London and other large towns at a profit. The question is an important one, for the success of the motor omnibus would be a serious matter for those corporations which have—as in London—invested immense sums belonging to the ratepayers in electric tramways. It is too soon as yet to express a confident opinion as to the financial possibilities of the motor car, but, as matters stand, the evidence points to loss rather than profit, any way in London. Only recently four motor omnibus companies were amalgamated under circumstances which left much to be desired. Another has had a meeting of shareholders this week at which the admission had to be made that all the subscribed capital has been spent, with little to show for it. The companies complain that their embarrasments are largely due to vexatious interference on the part of the police authorities, who insist upon expenditure that is unnecessary, and restrictions that are indefensible. But that is an *ex parte* statement, not to be accepted without reserve. That the motor omnibus is of great convenience to the travelling public where electric tramways are not available will hardly be disputed, but it is equally indisputable that the noise and smell which accompany them constitute a public nuisance, which has seriously depreciated house property in many districts, and is the cause of much personal annoyance in all. It is pretty safe to say that these grave drawbacks to the multiplication and even continuance of motor omnibuses will be overcome in time. It is claimed by some of the companies that they are already overcoming them. If and when that becomes true of the ordinary vehicle a great extension of this method of transport may be expected. It is said that, apart from the objections which make a section of the public the enemy of the motor omnibus, it cannot be run at a profit at present rates of carriage. If that be so, and there would seem to be ground for the conclusion, the companies may be expected to come to some working agreement under which fares will be raised. Negotiations having this object in view have been proceeding for some time, and the public will pay a higher fare rather than return to the horse vehicle. But it is indispensable that the objections to these vehicles due to their noise and smell shall be grappled with if they are to be left free to select any route that pleases them.

Docks and Steamers. — One of the strongest arguments in favour of the immediate deepening and improvement of the Port of London is that without it the great ocean steamships will not be able to use it since the draught of water they require is constantly increasing. The same difficulty is being experienced elsewhere. For example, the Cunard Company are seriously concerned at the state of things at New York as it effects their two great steamships, the *Lusitania* and *Maritania*. Dredging operations were begun in New York harbour some six years ago, and it was expected that the work of making a channel 35 feet deep at low water and 1,000 feet wide would have been finished last January. But in America, as elsewhere, delays have to be reckoned with, and it is now said that the new waterway will not be ready for another year at least. Meantime, and putting aside the *Lusitania* and *Maritania*, there is said to be at least a dozen liners entering the port of New York that cannot load to their full cargo capacity. At high water the passage is so risky, even for vessels drawing 30 feet, that owners prefer a loss in freight to the chance of their vessels going aground. The Government dredgers are said to be too small, ill adapted for the hard spots, and not powerful enough. It is a little surprising that the New York port authorities are backward in a vital matter of this kind, but the harbour authorities of most of the great ports of the world have, for one reason or another, failed to keep pace with the developments in ship construction. It means, of course, large capital outlay not always easy to arrange, and so postponed much to the inconvenience and loss of shipowners.

The Shipbuilding Industry.—The Board of Trade returns of the output of new ships in the six months ended June 30th last shows a large increase upon the corresponding period of last year, which itself was exceptionally large. In the six months exports numbered 764 vessels of 319,740 tons, valued at £5,571,847, as against 500 vessels of 209,180 tons, valued at £5,811,192 in the corresponding month of 1906. The decrease in valuation notwithstanding the large increase in output is due to the larger tonnage of war ships exported last year, and this makes the increase of merchant steamers all the more remarkable, the figures being 290,906 tons as against 185,505 tons in 1906. The figures here given relate to new vessels only. They do not include sales of second-hand steamers to foreigners. Also the launches and exports of the six months represent contracts booked in the early part of 1906, and probably include some booked as far back as 1905. They are no index to the new business of the present year. Nor is all the new tonnage as yet in commission. It represents the hopes of 1905-6 rather than the realities of 1907. The trade is less active than it was notwithstanding demands for increased wages. There are vacant berths in many yards. Lloyds' returns show that at the end of June there were 564 vessels "under construction" in the United Kingdom, of a united tonnage of 1,250,318 tons. These figures exclude war ships, and "under construction" includes vessels which have been long in the water though stiil in the builders hands, as well as those on the stocks. It must be taken, therefore, that the 1,250,318 tons includes much of the tonnage which figures among the launches of the present year. The total is less by 56,000 tons than the corresponding total at the end

of March last, and 160,000 tons less than the corresponding total at the end of June, 1906. Lloyd's figures show that there has been considerable shrinkage in the amount of the work in the hands of the shipbuilders; the largest decline being on the Tyne and the Clyde. Nor have new contracts been booked of late to make up for this decrease. It is said that in Scotland the new orders, booked in June, represent only 36,000 tons, as against some 65,000 tons launched. Low freights, high prices of material, increased cost of labour, all militate against new shipbuilding contracts. The shipbuilder was compelled to advance his quotations, and naturally the shipowner has put off as long as possible giving new orders. The prospects of the freight markets have not encouraged him to pay higher prices, and there was the probability that the demand for the raw material of the iron and steel industries would slacken and so enable the shipbuilder to reduce his quotations. It must be remembered too that the new tonnage now in the water is very large, and it would seem to be in excess of the carrier's requirements. On the whole it it is probable that the shipbuilding industry will not be very active during the remaining months of the year.

Cotton Profits.—If the figures given by Mr. William Tattersall in his cotton trade circular are accurate, cotton trade profits for the last half year were exceptionally large. He gives a list of 37 cotton spinning companies which have just taken stock for the six months, and the figures show at the rate of 40 per cent. per annum on share capital, or 30 per cent. on all capital employed. The total share capital is £1,451,741, and loans £514,129. A result of the continued prosperity of the cotton industry is that it is intended to "play" for a week longer this summer, so as not to overload the market. The reports as to the cotton crop are much more favourable owing to the improvement in the weather, and an output of 13,000,000 bales is now expected in some quarters, but the Department of Agriculture at Washington does not as yet support the most sanguine expectations. It made the improvement during June only 1½ per cent. Other reports have put it from 4 to 6 per cent., but even then have left the figures below the previous low record for July 1900, when it was 75·8. Although the weather has generally improved, it is said to have been so hot and dry in Texas as to cause fears that drought may be threatened in that State, where the plant is generally small, and the stands are rather poor. It would seem that at least, so far as this State is concerned, unusually good weather is required from now onwards, with a late fall, if serious shortage in the crop is to be avoided. Given good weather for the rest of the growing season an average crop may be gathered, but at present the probabilities seem to point to its being somewhat below the average. On the other hand the demands of the world's trade continue to increase, and possible shortage of the raw material in America will hardly be made up elsewhere. In this connection it is interesting to note that the Co-operative Wholesale Society, Limited, which represents in a special degree the cotton operatives of Lancashire, has invested £2,000 in the British Cotton Growing Association, whose object is the securing of a constant and sufficient supply of cotton from within the British Empire.

The Beneficial Effect of Prosecutions.—In her report to the Chief Inspector of Factories, Miss A. M. Anderson directs attention to what she considers the great benefit of successful proceedings taken against employers who have contravened the law notwithstanding every opportunity of knowing its provisions. She quotes to endorse the opinion of Miss Vine, another lady inspector, that no method of administration is so fruitful in good results in a district as a successful and widely-reported prosecution, at a hearing at which the magistrate has not only imposed heavy penalties, but also strengthened the inspector's hands by a few serious words as to the quality of the offence, and as to the issues involved when the laws passed mainly for the protection of the physically broken members of the State are not adequately enforced. It does far more good, in Miss Anderson's opinion, than a hundred instructions and cautions. For instance, after prosecuting one large firm, employing thousands of workpeople, Miss Anderson found, on visiting on an early date several other of their factories, that not only had prevalent infringements been rectified, but that, in addition, other matters regulated by the law had received the careful attention of the firm in question. The same thing is said to happen with reference to other factories under different management, situated in the same district. The day after another successful prosecution, in connection with which the magistrate's words in cautioning the defendants had been widely reported in the newspapers, on visiting other factories in the neighbourhood, Miss Anderson found all the employers unusually keen in carrying out the regulations of the Factory Act, one large firm having that morning sent for a plumber to remedy defects which, so far as Miss Anderson could judge, had existed for many months, simply because they had seen in the papers the account of the prosecution.

OBITUARY.

DR. DUPRÉ, F.R.S.—August Dupré, Ph.D., Chemical Adviser to the Home Office since 1873, died at his residence at Sutton on the 15th inst. He was born at Mainz on the 6th September, 1835, and after attending the Polytechnic schools at Giessen and Darmstadt he studied chemistry under Bunsen at the Universities of Giessen and Heidelberg. He graduated Ph.D. at the latter university in 1855 and then

came to London, from which time he made England his home, becoming a naturalised British subject in 1866. In 1864 he became lecturer on chemistry at Westminster Hospital Medical School, a position which he held until 1897. As chemical adviser in explosives he took an active part in investigating the explosives found in London and elsewhere during the Fenian outrages in the early part of 1883. In conjunction with Sir Vivian Majendie he saved Birmingham from a great calamity by himself rendering secure the nitroglycerine found in Whitehead's factory, and arranging for its safe disposal. He was joint author with Dr. Thudichum of a treatise on the "Origin, Nature, and Varieties of Wines," and with Dr. H. W. Hake, of a "Short Manual of Inorganic Chemistry." He also contributed a large number of papers to the various scientific journals. He was elected a Fellow of the Royal Society in 1875, and a Member of the Society of Arts in 1896. He was President of the Society of Public Analysts in 1877-78.

GENERAL NOTES.

Cotton Seed.—In his report on the trade and commerce of New Orleans in 1906 (Cd. 3283), Mr. Consul Carew-Hunt refers to the expansion of the cotton seed product industry in recent years in the United States. Not many years ago very little use was made of cotton seed except as a fertiliser. Now the products obtained are some of the chief articles of export from the South to European countries. Denmark is one of the largest buyers of cotton seed meal and cake for her large dairy industry. The cotton seed product inspectors at New Orleans send in the certificates giving the quality, as also the analysis for protein and ammonia, for all cotton seed products shipped. Their decision is considered as official by the trade, and has much facilitated business in these articles. There are 45 cotton seed oil mills in Louisiana.

The Trade of Russia.—It may be gathered from Mr. Consul Thesiger's report on the foreign commerce of Russia and trade (Cd. 3283) in 1906, that the political unrest had much less prejudicial effect upon trade than was generally supposed. The business done by the various mills and factories of the St. Petersburg district was exceptionally good, only the Metallurgical Works suffering from a shortage of orders. The value of goods imported into Russia from the United Kingdom in 1906 amounted to £11,040,000, or £990,323 more than in the previous year. The exports were, however, less by £2,503,684, the diminution being almost entirely due to the decreased export of grain. New regulations have recently been drawn up and sanctioned by Imperial Order relative to the placing of orders for the Russian Government in Finland and abroad. Finnish works are to be considered on the same footing as foreign works in regard to Russian Government contracts, and they are no longer to be allowed to compete with native works. But, other things being equal, in cases where orders are to be given to other than Russian works, preference is to be given to Finnish. At the close of 1906 the deposits of the State savings bank was said to have exceeded £104,266,666, without taking into account interest to the amount of £3,125,000. In addition, there were in the savings bank at the end of the past year paper securities to the value of £24,583,333. During the last decade—1897-1906—the deposits more than doubled, while the paper securities increased more than five-fold. In 1905 there was a decrease in deposits of £11,083,333, but in the following year there was an increase of £17,656,250, which not only wiped out the decrease of 1905, but left a net increase of £6,572,917, as compared with 1905.

The Uganda Railway.—The extract from the report of the acting manager of the Uganda Railway published as an appendix to the report on the East African Protectorate for 1905-6 (Cd. 3285) shows that the railway is making satisfactory progress. The result of the year's working was a net profit of £56,878 compared with £2,639 in the previous year, and a dead loss of £60,100 in the year 1903-4. The gross receipts amounted to £204,928 as against £153,794 in the previous year, and £131,567 in 1903-4, an increase of 33·25 per cent., and 55·76 per cent. in each succeeding twelve months. The percentage of expenditure to gross earnings in the year under review was 72·34, against 98·29 in the previous year, and 145·68 in 1903-4. The steamboat service increased its earnings from £14,466 to £22,340. It did a business larger by 50 per cent. for the same money. Coaching traffic shows less improvement than earnings under goods and steamers, yet it has increased from £35,199 to £43,180 (some 22·69 per cent.), but the margin of profit is small—small, that is, for the country,—nor is it likely that any reduction would largely increase the numbers travelling, or induce a more paying business. "In the immediate future," says the Acting Manager, in his report, "it is a hard struggle for the pioneers, and although it may be encouraging to see rates for fibre, rubber, cotton, &c., lowered, yet (except where capital is behind them), the growers are sorely pinched by the high rates of many of the principal necessaries of life—flour, rice, sugar, &c., all of which are exceedingly expensive up country, due to the high cost of carriage." The Uganda Railway was not projected as a money-earning system; its aims are far broader—the development of a new country, and the smaller the surplus over the working expenses during the next few years the better. For some years, at any rate, a portion of the increased earnings will be used for the improvement of the line and the reduction of rates.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

FOTHERGILL PRIZE.

FOR LIFE-SAVING APPARATUS FOR USE IN NOXIOUS ATMOSPHERES.

The Council of the Society of Arts are prepared to award, under the Fothergill Trust, a Gold Medal, or a prize of £20, for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious.

It is intended that the apparatus sent in shall be submitted to practical trials and tests.

In the award of the Medal regard will be had, firstly, to excellence of design and contrivance, and, secondly, to excellence of manufacture. Credit will be given to such parts of the apparatus as are the invention of the exhibitor; the object being to distinguish the apparatus which gives the best promise of being practically useful.

Inventors intending to compete should send in a notice of their intention, together with a full description of their inventions, not later than 31st March, 1908, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.; and in cases in which the apparatus has been put into actual use, the experience of such use should be given, and the special points of merit of the apparatus indicated.

Notice of the place to which the apparatus is to be sent will be subsequently given to those competitors whose apparatus the judges may desire to test, together with an indication of the tests, and of the manner in which they will be conducted.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

STOCK PRIZE.

FOR THE DECORATION OF PART OF THE INTERIOR OF A BUILDING.

The Council of the Society of Arts are prepared to offer, under the terms of the Stock Trust, a Gold Medal, or a Prize of £20, for competition amongst the students of the Schools of Art of the United Kingdom, at the Annual Competition to be held in 1908.

The Prize is offered for the best original designs for an Architectural Decoration, to be carried out in painting, stucco, carving, mosaic, or any other process.

This Architectural Decoration is to be for the side of a room or a hall, a ceiling, the apse or side of the chancel of a church, or any suitable part of the interior of a building.

The designs must be on imperial sheets. Each set must consist at least of a coloured drawing to scale of the whole design of decoration, and two coloured drawings of details on separate imperial sheets. Mere patterns or sketches of details, without the mouldings or borders necessary to make up a complete decorative scheme, will not be taken into consideration. The designs must have been made between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1893 or 1897 cannot compete again.

The designs are to be submitted, with other school work, in the usual manner, to the Board of Education, South Kensington, in April, 1908. Each of the imperial sheets, forming a set of competing designs, must be marked, "In competition for the Stock Prize," in addition to being labelled or staged according to the Regulations of the Board of Education.

PROSPECTS OF INDIAN MANGANESE INDUSTRY.

By A. Ghose, F.C.S.

According to the latest available official statistics the total import of manganese into the United Kingdom during the last year amounted to 490,612 tons with a declared value of £865,443. Of this India contributed 129 990 tons, valued at £359,925. The largest quantity from India was exported through Bombay, and the figure reached 92,700 tons of ore, mainly from the rich mines of Nagpur, Balaghat, and Bhandara districts of the Central Provinces, and from Jhabua State in the Central India Agency. From Madras 7,819 tons were exported to the ports of the British Isles. This represents a fraction of the output of Vizagapatam mines, most of which is consumed by Continental furnaces. Calcutta exported 20,370 tons, and as there are no important manganese deposits at present being worked in Bengal, it is safe to assume that the above quantity was derived from the mines of the Central Provinces. Through Marmagoa Harbour, in Portuguese India, 9,101 tons were shipped. This came from the Kumsi mines in the Shimoga district, Mysore State, and Ramandrug mines in the Sandur State, Bellary district.

The figures quoted above do not apparently present any striking facts as to the growth of the manganese industry in India. But when compared with the import of manganese from India in 1905 into the United Kingdom it becomes evident that the demand for Indian manganese has grown with extreme rapidity. In 1905 Indian export of manganese to Great Britain totalled 71,660 tons, and it is clear that last year's supply reached nearly twice the above figure. The most significant feature of the import of manganese into the United Kingdom is that India headed all the countries which supply the British furnaces with manganese ore, Brazil with 127,257 tons being second, Russia coming next with 103,276 tons.

From the above, it will be seen that India has attained a leading position in the world's manganese market. The total output of Indian manganese during 1905 reached 281,734 tons. This figure has been far exceeded during the past year, Bombay alone shipping over 310,446 tons, as the partial closing of Russian mines, the enhanced price and increased demand gave an impetus to the industry with the result that several important mines were opened, and large quantities were shipped from new localities.

The demand for Indian manganese ore for Continental furnaces is steadily increasing and the quantities shipped to Belgian and German ports exceed the export to England. The high grade ore of the Central Provinces even finds a market in the United States, and heavy shipments were made to the ports of Baltimore and Philadelphia during the past year.

The increase of the world's steel production is the key to the greater demand for manganese, and the supply is influenced by the partial failure of the Russian mines, hitherto the largest producer of manganese. Besides numerous railway extensions, and naval and engineering projects, the earthquakes of San Francisco, Valparaiso and Kingston have led to the placing of large orders for steel structures, and since the manufacture of ferro-manganese and speigeleisen depends on manganese, the demand is natural.

The stability of the Indian manganese industry and the extraordinary demand may be well gauged by the fact that some of the foreign consumers have already acquired or are negotiating for the purchase of manganese properties in India. It is said that a large deposit of ore in the Balaghat district, Central Provinces, has been secured for the Carnegie Syndicate. Another property in Mysore has passed into the hands of a German firm. These transactions form a convincing proof of the quality of Indian ore and the shortage of foreign supply.

An idea of the extraordinary demand may be formed from the fact that shipments have been made of ore containing as low as 33 per cent. of manganese metal. It is doubtful whether such inferior ore has ever before been exported from India. Inquiries have also been made for the purchase of manganiferous iron ore containing 30 per cent. manganese. The market conditions are such that the buyers have relaxed the standard of purchasing ore and are paying good prices even for low grade ore, which is thus able to bear the heavy sea freight in addition to mining and transport charges.

With the re-opening of some of the mines in the districts of Sharopan, in the Caucasus, and Nikopol, in the Donetz region, Russia is trying to regain her former supremacy in the manganese market. But so long as the provinces of the Caucasus remain unsettled, there is no likelihood of Russia largely increasing her output so as to bring about

a fall in the price. The fact is that some mine-owners and exporters at Poti and Batoum having broken their contracts by failure to deliver, the confidence of buyers in Russian ore is shaken, and it has been found much safer to rely on Indian producers. In this connection, some of the most prominent men actively engaged in manganese business paid visits to India this year to satisfy themselves as to the capacity of certain important Indian manganese mines and to place large orders with reliable shippers of ore, and several forward contracts for heavy consignments have been made.

The average percentage of manganese metal in ordinary Russian ore is about 50. The quality of the Russian ore is no doubt excellent, but sometimes the presence of an excess of silica and phosphoric acid places the Russian ore in a disadvantageous position in comparison with certain Indian ores which are low in silica and phosphorus, and thus better suited for the requirements of the smelters. The ore from the most important Russian mines of Transcaucasia—at Tschiatura, in the province of Kutais—mainly consists of pyrolusite, which is the softest ore of manganese. An idea of the softness of this ore can be formed from the fact that a single miner can extract over ten tons of ore in the course of a day simply by means of a pick-axe. Such pulverulent ore is almost unknown in India in workable quantities, except in some deposits in the province of Goa in Portuguese India. This softness of the Russian ore has an important bearing on the demand for Indian ore. The Russian pyrolusite and allied ores, when shipped and delivered at the smelters, are partly reduced into a powdered state, on account of which there is not only loss in the transit, which results in shortage of quantity, but a portion of the finely-reduced powder is further lost at the time of metallurgical treatment. On the other hand, the Indian ore, with its compact structure, hardness and friability, and comparative absence of dust ore, is easily handled, and is better appreciated by smelters. Thus it will be seen that, even if the Russian production is increased, the superior quality of the Indian ore in the above respects will find ready purchasers.

Brazil has long been a serious competitor of India in the manganese market. Although much of her ore is consumed in the United States, still the exports to Europe reach a high figure. The quality of Brazilian ore approaches that of the ore exported from the Central Provinces mines, the percentage of manganese in both being high sometimes containing as much as 55 per cent. It is an open secret that some of the important mines in Brazil, which have been worked for several years on a large scale, are exhausted, or are about to be closed. The principal mines are in Queluz district, in the State of Minas-Geraes, and in Bahia. The exhaustion of some of the deposits cannot impair the manganese resources of Brazil, as there are not a few deposits still unexploited. In the State of Matto-Grosso, near the Bolivian frontier, an extensive deposit has already been prospected. This deposit in Corumba has just been leased out to a Belgian company with a capital of 7,000,000 francs. It is favourably situated, being a few miles from Paraquay river, and will ere long begin shipment.

Of late much has been said in favour of the newly discovered deposits of manganese in Borneo, and in uninformed quarters it has been whispered that the working of these will seriously affect Indian manganese trade. But this apprehension is not founded on a solid basis. The quality of Borneo ore has been found to be low, and the silica content of this ore is above the ordinary trade requirements. Apart from the quality, the distance of Borneo is not favourable for securing lower freight for the ore.

It has been pointed out by an eminent authority that India is a loser by exporting raw manganese ore instead of ferro-manganese. It is true that the price of ferro-manganese is several times that of even the highest grade ore. But India is a country where everything moves slowly, and it is also the mine owners' "Land of Regrets" in not a few respects. In England there are large beds of iron ore almost side by side with seams of coal of high quality. By irony of fate it is just the contrary in India, where the existence of immense deposits of iron is synonymous with the entire absence of fuel. That is almost invariably the case with manganese also. It may be possible to smelt and reduce manganese ore either by importing coal, or by transporting manganese to the neighbourhood of Indian coalfields where facilities exist, and to export the product with profit. It is evident that in this way even the low grade ore, thousands of tons of which are wasted every year in India as unfit for shipment, can be profitably utilised. But enterprise is yet wanting in this direction.

Recently a proposal has been made to the

Russian Government to impose an export duty on Caucasian manganese ore. If this is given effect to, then it will stimulate the Indian manganese export. As the export of the ore to Continental and British ports is more profitable, it has been found difficult to get supplies of manganese for the furnaces in the south of Russia, and the difficulty has increased so much this year that a large number of furnaces are idle, and some of the most important steel works are closed. This fact is in strong contrast with the opinion of those who condemn the shipping of the raw ore from India instead of its conversion into ferro-manganese locally, which can certainly be exported with greater ease and profit. If in a European country, famous for its manganese production, where numerous furnaces already exist, it is found necessary to close many of them for shortage of supply because the export of the raw material is preferred, then what guarantee is there that if smelting works are erected in India, the supply of ore will be kept up, unless the mines and furnaces are controlled by the same agency?

A new era of mining activity and metallurgical industry is dawning upon India. We are about to see the opening of the long-talked-of largest iron and steel works in India, at Sini on the Bengal-Nagpur Railway. The re-opening of the vast belt of copper ore in the Singbhoom district may lead to the extraction of copper in the near future. The immense but long neglected deposits of aluminous laterite have been proved to be inexhaustible sources of alumina and hence of aluminium by the Indian Geological Survey and await development and utilisation. The establishment of metallurgical works for the manufacture of ferro-manganese is only a question of time and capital. In this connection it is interesting to note that the Government of Mysore specially deputed Dr. Smeeth, the head of the State Geological Department to Scandinavia, to visit the centres of electro-metallurgical industry there. Recently the Secretary of State for India placed Mr. Holland on special duty in Europe, and one of the questions studied by him relates to the manufacture of ferro-manganese and spiegeleisen in India. The reports of the above officers which must contain vastly important informations are withheld from the public probably pending the decision of the authorities concerned.

An instance of what can be achieved by the conversion of water-power into electricity and its employment in smelting may be cited here, although the electro-metallurgy of manganese is not yet in a very far advanced stage. In the south of France, in the Pyrenees, there are veins of rhodonite, a silicate ore of manganese (which is thrown away in some of the Nagpur mines) which on account of extremely high percentage of silica and low metallic manganese content cannot bear the cost of transport. But the proximity of these deposits to waterfalls has led to the electro-metallurgical reduction of this ore and the product is exported with much profit. In India, except in Goa and near Munsar in the Nagpur district, waterfalls are not known to exist in the vicinity of manganese deposits. The low quality of Goa ore will well-repay the electro metallurgical treatment. Perhaps it remains for the Government of Mysore to take the lead in the preparation of ferro-manganese in India, which if accomplished even on an experimental scale, will result in the establishment of larger works. It is hoped that the third installation in the Cauvery Falls power station recently undertaken, which will develop an additional 2,700 British horse-power under a fall of 380 feet, will afford means for demonstrating that ferro-manganese can be prepared with advantage locally. The harnessing of the Niagara Falls has led to the establishment of most important electro-metallurgical works on both the States and Canadian sides. But in India, the immense falls of Gersoppa still remain unexploited.

The disorganisation of the Russian manganese industry has led to vigorous ef[illegible]rts bei[illegible] have undertaken in order to find a s[illegible] 33 per manganese in the Bessemer o[illegible] [illegible]ubtful carbonising iron. An addition of [illegible] salt followed by small quantities of coke thrown into the molten metal, has been found to facilitate this operation, and this treatment has been tried with success at Homecourt. This process does not dispense with the use of manganese, the quantity of the ore ordinarily used in the operation being only reduced. India, with her inexhaustible deposits of ore, has not so much to fear from the competition of other manganese-producing countries. But it is probable that, at some distant date, the manganese industry may be completely displaced by the discovery of some artificial means as a substitute for manganese in the manufacture of steel, and to this end not a few chemists and metallurgists are labouring. But the accomplishment of this will take

several years, and manganese miners need not be alarmed at present.

The export of pyrolusite, the dioxide of manganese, for the manufacture of chemicals, has not yet taken place from India, although this ore has been met with in some places. There is a remarkable deposit of this in combination with other manganese ores at Pali, about six miles from Munsur, Central Provinces. The ore has yielded 62 per cent. of manganese. Pyrolusite is often met with in Goa deposits in quantities worth exporting. As the price of pyrolusite is much higher than that of the ores used for the metallurgical purposes, it is worth while for those who find it in sufficient quantity to sell it to the manufacturers of chemicals. But for this, the trade requirements are such that only pyrolusite of high purity can be sold. For the use of glass manufacturers, it should be free from iron. The utility of manganese in glass manufacture consists in its peculiar property of discharging the brown and green tint due to the presence of iron in the sand. This is why the French call this variety of ore—"le savon de verriers." For the manufacture of chemicals such as bleaching powder, the ore is sold on oxygen value basis, and should be free from iron and lime compounds to prevent the unnecessary waste of acids. But the presence of silica is not objectionable. Japan is at present one of the chief producers of pyrolusite, and during the last year, 320 tons, worth £800, were exported to the United Kingdom by that country. A quantity of pyrolusite has recently been exported from a Cape deposit. Owing to its softness and brittle nature, this ore is conveyed in bags. The utilisation of the bye-products of coke manufacture by the introduction of recovery ovens in the Giridih coalfield marks a distinct advance in the chemical industry of India. The local manufacture of chemicals in which manganese plays an essential part, is also a subject worthy of serious consideration in India.

Although the Geological Survey of India published long ago notes on some manganese deposits in India, and Ball in his monumental work on "Economic Geology," noticed some of the principal deposits, still the importance of working them was hardly realised, and it was left entirely to private enterprise to start the manganese mines in Vizagapatam district, in the Madras Presidency, and the Nagpur, Balaghat and Bhandara districts in the Central Provinces. The pioneers of the industry in the above-named districts cannot be sufficiently praised for their bold venture, as they discovered and started the mines on their own initiative, in spite of scanty reports and encouragement. On the other hand, it is curious that the Geological Survey records contain an exhaustive report on the deposits of manganese in the Jubbulpur district, in which the value of these deposits has been specially pointed out; but these deposits still remain practically untouched, as they cannot compare in importance with other great Indian deposits, which were mostly discovered through the efforts of private individuals whose names remain unrecorded. Active interest in manganese deposits taken by the Geological Survey of India properly dates from the appointment to the directorship of Mr. T. H. Holland, F.R.S., that distinguished geologist who has done so much for the promotion of Indian mineral industry. The researches with regard to manganese deposits, inaugurated by Mr. Holland and ably conducted by Mr. Fermor, may appear to a certain class of men as mere scientific speculation, with a view to add some more names to the already long list of minerals, economic and otherwise. It is needless to say that such views fail to appreciate the importance of scientific investigations, specially those directed to unravel the origin of manganese deposits. These researches are likely to lead to the identification of manganese-bearing rock series in still unexplored parts of India, as it is more than certain that a great many manganese localities in India still remain undiscovered.

The manganese quarries of Vizagapatam district have been worked for about ten years, and some of them have approached exhaustion. The situation of these deposits is excellent on account of the proximity of a sea-port, and this has resulted in profitable exploitation of a middle-grade ore, containing high percentage of phosphorus, suitable for the basic process. The important mines of the Nagpur district in the Central Provinces are mostly situated in the neighbourhood of Kamptee, and the ore produced in that locality is of the highest grade so far exported from India. Only sometimes the percentage of silica exceeds the limit of standard requirements, a disadvantage evidently due to the preponderance of braunite in the ore of this locality. The deposits at Ramtek, Munsur, Kachurwahi, Manegaon, and Kodaigaon, are all noted among others for the excellence and abundance of ore, mainly an intimate mixture of braunite and

psilomelane. The newly opened mines in Bhandara and Balaghat districts are said to show extraordinary development of ore bodies, and are being actively exploited, several light railways being built to ensure heavy export. The deposits of manganese in the Chindwara district, on account of transport difficulties, are in a disadvantageous position in spite of the richness of the ore. A deposit is being worked with success near Meghnagar in Jhabua State, Central India Agency. The comparatively unimportant superficial deposits of manganese ore in the Jubbulpur area, and in the neighbourhood of Chaibassa in Bengal, are also being worked on account of the prevailing high price of the ore. In Mysore, Shimoga, Chitaldrug,, and Tumkur districts, are pratically in the hands of manganese exploiters, hundreds of miles having been taken up under exploring or prospecting licenses. A large quantity of good ore consisting of psilomelane has been exported from the boulder beds in the neighbourhood of Kumsi which are being worked extensively, and new deposits are being opened out in the Shankargudda Range, and in the Tumkur, and Chitaldrug districts. In the Sandur State in the Bellary district mining operations are proceeding on a large scale; the ore of this locality being non-silicious and non-phosphoric is in great demand. In Portuguese India the craze for manganese has reached its highest limit, and the speculative element is at its maximum. The deposits are all in laterite, and although there is a considerable quantity of good ore, the life of the majority of the deposits is limited, only few of them being of commercial importance. Among these are the mines at Sancordem, Candiapar, Fanuswadi, and Wagy; from these mines export has taken place. The proximity of Marmagoa Harbour affords exceptional facilities for working with profit even an inferior quality of ore. There are isolated manganese localities near Talewadi and Khanapur, in the Belgaum district. Deposits have also been found in the Kristna district.

The search for new localities is being conducted so vigorously that it evokes admiration, although the ignorance of the majority of explorers and their patrons leads to the exploration of barren tracts where the chance of finding manganese is remote. However, this is an indication of an awakening interest and recognition of the possibilities of the mineral resources of the country. The construction of the railway line between Raipur and Vizagapatam will bring to light not a few metalliferous deposits in that area, as it is presumed that the manganese-bearing rocks of the Central Provinces extend into the country to be traversed by the railway under construction. Dr. Walker, late of the Geological Survey, noticed the existence of manganese in the Kalahandi State, and there is reason to suppose that there are several out-liers between Raipur and Vizagapatam which deserve exploration. Manganese has also been found in Kalicotta and Kalahasti State. The Dharwar rock series in Mysore and the Bombay Presidency should receive special attention, as this formation is the most important repository of manganese ore in Peninsular India.

The scarcity of the ore, and the consequent high prices, have led to active exploration for manganese all over the world, and have resulted in the finding of numerous new localities, most of which are unimportant. The search for manganese has even penetrated into the polar regions. Promising deposits have been found in South Africa and St. Helena and some of the abandoned deposits in England are being reopened. The discovery of a number of payable deposits in other countries and the reopening of Caucasian mines will in all probability lead to over-production. Even in India the tendency is in that direction and a shortage of supply of wagons on the railways concerned with manganese traffic is a mere question of time. It is probable that the deposits in the Sandur State and also some in Mysore, on account of their immense reserves of ore and nearness to the sea, may take an important part in the world's production, and Marmagoa harbour is likely to surpass other Indian ports in manganese export in the near future. But the present capacity of that harbour is extremely limited, and unless this is promptly remedied the South Indian manganese industry will receive a serious check. The over-production of ore in India and elsewhere is greatly to be feared as this is bound to influence the market and will result in the reduction of the price. A combination of all the important mineowners of India could have averted the competition to a marked extent. But, unfortunately, this is almost out of question. The day of artificial substitute is not yet, and so long as there is no over-production India's present position in the world's manganese market may be regarded as safe.

WIRE ROPEWAYS.

This form of modern transport is one which is developing rapidly, and as it works absolutely mechanically, and at a comparatively small original cost, it provides a cheap and economical means of conveyance. The advantages of the system are fully recognised by experts, and it naturally follows that its employment is increasing in all parts of the world. To-day, ropeways of very great length come well within the region of possibilities, and neither the difficulties of the ground nor the influence of the weather offers any serious obstacle to their erection. It may, in fact, be safely said that in many cases—for instance, when it is a question of systematically opening up mineral treasures in steep and unapproachable mountain regions—this means of transport is absolutely without competition. The working of the enormous and rich lodes of copper in the South American Corderillas, which, on account of their inaccessibility, lay either untouched or were at least very inadequately worked with the inefficient means of transport available, could never have been entertained without recourse to the railway through the air, as a railway track may be considered as an impossibility at heights ranging to 6,000 metres.

The most perfect picture of the modern wire ropeway is no doubt the unique ropeway built some little time ago by Messrs. Adolf Bleichert and Co., Leipzig-Gohlis, in the Argentine Andes, and which, running from the town Chilecito to the Famatina Mines, at a height of some 4,600 metres above the level of the sea, may be said to form a continuation of the State railway. This wire ropeway, a masterpiece of engineering, is not only the most elevated railway plant in the world at its upper end, but nowhere else has a steam-engine ever been erected at such an elevation as here. The track has a length of about 35 kilometres with a difference in level between the two terminals of about 3,500 metres, and is in other respects the most difficult plant of this description which has ever been built and put in work. It must not be forgotten that this ropeway has to deal with general traffic. Not only is the ore brought down from the heights to the railway and the smelters, but all building material for the mines and the necessaries of life for the workmen must be carried up. It is also employed for carrying the mails, and the officials even use it for passenger traffic. The introduction of this plant with a capacity of 40 tons down traffic, and about 20 tons up traffic, reduced the cost of transport from something like 50s. per ton to about a tenth of this sum, and thus rendered it possible to compete on a large scale in the foreign market. The success which this plant has attained has led to the erection of further Bleichert ropeways in the neighbouring mines in Argentina, as also in Chile. Very similar conditions rule in Japan, where the same firm has also built several important and difficult plants for working copper mines in mountainous regions. These are several kilometres long, with considerable differences in level, so that with their spans of from 400 to 600 metres they may well be ranked with the Argentine ropeway.

In conclusion, the employment of this transport system in connection with loading plants must not be forgotten, whereby landing stations on otherwise inaccessible coasts have been made possible. In such cases wire ropeways can again be said to be indispensable, as no suitable substitute can be found. The plants carried out by Messrs. Adolf Bleichert and Company on the coast of Spain, on the island of Elba, and in New Caledonia, which have capacities up to 250 tons per hour, prove conclusively that there are no limits to the employment of wire ropeways, and neither ground nor harbour conditions can offer insurmountable difficulties to the erection of such means of transport.—*World's Carriers.*

THE MINT.

The report of the Deputy-Master and Comptroller of the Royal Mint directs attention to the increase in the loss per million sterling on the gold coinage. This loss is almost entirely due to the inferior quality of much of the gold bullion received. The presence of the impurities which cause the brittleness is not detected by the ordinary test made by assayers, and is not revealed until the bullion sent for manufacture has been standardised by the addition of copper. Until 1870 the Master of the Mint had the right to reject gold bars found brittle in the process of coinage, but in that year, as the result of certain experiments, this regulation was rescinded. The new arrangement worked fairly well until 1899, when a considerable number of ingots refined from rough bullion originally produced by the cyanide process were imported. Since that date difficulties from brittle gold have occurred in 1902 and 1903, and the large proportion of this gold delivered for coinage last year raises the question in a very different and serious form. The Deputy-Master writes:—

"It may be assumed that the employment of the cyanide process is now largely established; that the ordinary process of refinement by sulphuric acid as practised in London gives unsatisfactory results in dealing with impure gold under modern conditions; and that this department is not provided with any means for economically purifying defective gold. The consequenee is that loss of time, grave public inconvenience, and additional cost, is incurred in the coinage of gold. These disturbing elements are not inevitable. Brittle bars are, I believe, quite unknown in the new mints of the United States, and in those of Australia, and the process of refining which it is proposed to instal in the new branch mint at Ottawa will, it is believed, ensure equally satisfactory results there. It remains, therefore, to be seen whether the process generally used in London can be so improved

as to cope efficiently with the impurities left by the cyanide process."

Referring to the same matter, Mr. Edward Rigg, I.S.O., Superintendent of the Operative Department of the Mint, says that the experience of the year has clearly demonstrated that when gold giving sound malleable bars is melted with copper to produce standard metal, the normal loss does not exceed two ounces per 10,000, corresponding to the average loss incurred in former years, but when the gold referred to above is similarly standardised it produces bars of varying degrees of brittleness, often so marked that the bar cracks in pieces on being struck lightly with a hammer, and is at the same time characterised by a largely increased melting loss—often nearly double the above amount.

SCIENTIFIC RESEARCH IN INDIA.

Amid the crowd of official reports produced in India there are many of general interest, deserving of note in this country. The "Report of the Board of Scientific Advice for India" is an annual of recent origin, but nevertheless appears to be destined to play an increasingly important part in the economy of the country. The Board itself was originally constituted in 1902, and consisted of the heads of the Meteorological, Geological, Botanical, Forest Survey, Agricultural, and Veterinary Departments, the Government reserving power to add other officers of special attainments as need might suggest. It was to be a central authority for the co-ordination of official scientific enquiry and for aiding the Government of India in questions of economics and applied science. Fresh officers have since been added to the Board, and from the Report for the year 1905-6, which is just to hand, the field of discussion and research would seem to be very wide. "Economic and Industrial Chemistry" records a variety of experiments in regard to india-rubber, resins, oils, dyes and tans, and medicinal substances. One of the most curious of these relates to a report of Messrs. D. Hooper and H. H. Mann on no fewer than 33 samples of edible clay, which they submitted to analysis. There is no food value in these earths; nevertheless they are commonly sold in the bazaars, more especially in times of scarcity. In the Bombay Presidency cimolite is baked and eaten, and hydrated silica in Madras and Travancore. Palia stone of Rajputana, consumed in time of dearth, is really talc schist; most of the other specimens are mixtures of sand and clay.

Passing by observations on solar physics, magnetism, and meteorology, which pertain rather to the domain of specialised science, note may be made of an interesting account of the mineral developments of the country. The total value of the minerals raised for which trustworthy returns are available increased from £5,357,840 in 1904 to £5,707,956 in 1905, while the number of licenses for exploring, prospecting, and mining issued rose from 151 to 189. The greatest activity in prospecting was shown in the Central Provinces, where manganese is the principal mineral sought for, and in Madras, where gold and mica received most attention. Gold dredging concessions granted on the Chindwin and Irrawaddy rivers and on the Nam-ma stream in the Northern Shan States were visited, and a report on them is now under the consideration of the Government of India. The ancient silver-lead mines of Baudwingyi to the east of the ruby mines, which were worked on a large scale by the Chinese up to the middle of the last century, were also reported on. Active exploitation of these mines is now in progress. The diamond mines of Panna State in Bundelkhand are also mentioned. The methods of working the deposit are very primitive, either by pits or shallow workings. The principal source of the stones is a conglomerate separating the Kaimur sand-stones from the Rewar shales, and they are considered to have been derived from the granite area of Bundelkhand.

In the domain of geography, Lieut.-Colonel S. G. Burrard, Superintendent of the Trigonometrical Survey, contributes two interesting papers to the Report. The first of these deals with the region of Seistan, near the tri-junction of the three States, Persia, Afghanistan, and Baluchistan. A great deal of information about Seistan has been acquired during Sir H. McMahon's recent Mission by Mr. G. P. Tate, of the Survey of India. Mr. Tate, who had much previous surveying experience in Afghanistan and Baluchistan, carried out a topographical survey of 42,000 square miles on the scale of 4 miles = 1 inch, and of 3,000 square miles on the scale of 1 mile = 1 inch. He is now preparing two maps and memoir, the latter with certain accounts of the ancient and present topography of Seistan as well as notes of its archæology and ethnology. The country of Seistan is formed by the delta of the Helmand, and supports a population of 105,000; it is comparable to the deltas of the Oxus, Jaxartes, and Tarim rivers, which also deposit their waters in inland lakes. Mr. Tate found that the Seistan lagoon was nowhere deeper than 10 feet; he estimates its area at 2,000 square miles. In the arid climate of Central Asia a quarter of an inch depth of water will be evaporated daily from an exposed surface, and it can be thus realised how rapidly the Seistan lagoon would become dry if the supplies from the Helmand ceased. The question still remains in the constant struggle that is going on between sand and water with which of these elements the victory will ultimately rest? In the case of the Seistan oasis, Colonel Burrard thinks that the sand is increasing while the water is not, so that the former must in the end prevail.

As regards the exploration of the Brahmaputra (which it may be remembered was recommended by the Royal Scottish Geographical Society) Colonel Burrard makes some suggestive remarks. He draws attention firstly to the curious

tendency of all its principal tributaries to flow in a direction opposed to that of the main stream, and deduces therefrom the inference that the Brahmaputra itself flowed from east to west along its present trough at no very distant date, and that the several tributaries were developed during that period of the river's history. If so the present passage of the river across the Himalayas into Assam in longitude 94° must have been formed under circumstances of extraordinary interest and mystery. The explanation suggested by Colonel Burrard is that the Brahmaputra, when it reversed its course, formed a great lake in South-Eastern Tibet, which overflowed over the southern ranges, and gradually cut a gorge across them. An interesting phenomenon of Himalayan geography is that where a deep gorge is thus formed by a river, the highest point of the range is often, if not generally, found in close proximity. For instance, Nanga Parbat, the highest point of the Punjab Himalaya, is fourteen miles from the gorge through which the Indus passes the range; Rakhi pushi, the highest point of the Kailas range, is within nine miles of the gorge of the Hunza river; Daulagiri is six miles from the Kali-Gandak; in escaping from Tibet the Sutlej appears to aim for the peak of Leo-Porgial, the highest point of the barrier range. Colonel Burrard offers no very confident solution of this curious feature, but there is no doubt that it would be peculiarly interesting to test by actual exploration whether the same phenomenon exists in the neighbourhood of the branch formed by the Brahmaputra through the Eastern Himalayas. The region in question is, however, a *terra incognita*, so we shall probably have to wait for the investigation of this physical problem.

HAND-LOOM WEAVING IN INDIA.

During the past twelve months the reorganisation of the hand-loom weaving industry has made considerable progress in the Madras Presidency, chiefly in the direction of establishing hand-loom weaving factories equipped with fly-shuttle looms. The most important of these factories is that established by the Government of Madras, under the direction of Mr. A. Chatterton, Director of Industrial and Technical Enquiries in the Madras Presidency, at Salem, where between 40 and 50 looms are at work, and where experiments are in progress to test the relative merits of different patterns of looms.

So far (says the *Indian Trade Journal*) no loom has been discovered by Mr. Chatterton that is superior for all-round work to the English hand-loom fitted with an automatic take-up motion. These are manufactured in the School of Arts, Madras, which can turn out a loom with a 54-inch reed space, exclusive of reeds and healds, for Rs. 85. The latter are sometimes of country make, but the best reeds and healds have been obtained from Blackburn, England, and cost 2½ annas per 100 dents and 5 annas for the corresponding number of eyes. The reeds are made of brass and the healds are fitted with steel eyes. Mr. Chatterton points out that in the loom described above cloths can be manufactured from yarn of coarse counts or a degree of fineness beyond that for which there is any considerable demand. The bulk of the work turned out by these machines is with yarn ranging from 60's to 100's; but, to demonstrate the practicability of weaving them, much finer cloths than these have been manufactured, and it is understood that in the hands of a skilled weaver this loom can be used for any class of work that can be done on the native hand-loom.

For the present, attention in the Madras Presidency is mainly directed to improvements in the methods of preparing warps and sizing them. Experiments in hand-sizing have proved a failure, and it seems almost certain that the present methods of sizing will have to be retained in any process of warping which may be devised. Already the use of warping mills is very common throughout the Madras Presidency, and in Salem, for instance, it is usual for weavers to get their yarn warped at a separate establishment where nothing else is done.—*Textile Mercury*.

THE SPANISH WINE TRADE.

Spain has made great sacrifices for the sake of her vineyards, and the loss of many of her forest lands, and resultant droughts may be traced to the manner in which extensive tracts of country were laid bare for the planting of vines. Doubtless at the time that the phylloxera made such ravages amongst the French vineyards and obliged France to look for her supplies south of the Pyrenees, the Spanish wine growers secured a rich return, but it was not long before the Spanisn vineyards were also attacked, and while the French growers lost little time in replanting, the Spaniards, being as a rule too poor to afford the necessary heavy expenses, were obliged to abandon their holdings. Within recent years some of the wealthier landowners have endeavoured to create special brands, in imitation of French clarets, and light, white wines, and some have already met with considerable success. Unfortunately, however, the majority of the wine-growers, possibly from necessity, have been content to adhere to their primitive methods and produce, so to speak, the raw material either for home consumption or for others to elaborate, and for which they have been obliged to accept whatever price the high protective tariffs of other countries have allowed. The United States Consul at Barcelona, reviewing the Spanish wine trade during the past year, says that prices steadily declined until the month of July, this being due in the first place to the abundant vintage of 1905 in the south-eastern part of Spain, and the excellent outlook for 1906, not only throughout Spain, but also in other wine-growing countries, such as France, Italy and

Portugal, and, in the second place, because of the termination of the commercial treaties with Germany and Switzerland. The extensive manufacture in England of wine from raisins, also in some measure affected the sale of Spanish wines in Great Britain. From August onward, the lack of rain began to injure the grapes, and prices began to recover, assisted by the commercial *modus vivendi* with Switzerland. At the same time the home demand improved, especially in the wheat-growing provinces, where the splendid crops had brought prosperity to the inhabitants. With the exception of sherry, the trade with the United States is unimportant. The recent commercial treaty may, of course, help the sale of Spanish wines in America, but leading growers and shippers do not anticipate any very great results from it. Altogether, the present condition of the wine trade in Spain is not very favourable. Many years, it is said, must elapse before the country can hope to secure a firm hold on foreign markets for her better wines, and not until the wine-growing districts of Rioja, Aragon and Valencia are able to produce the same quantities they formerly did. It is estimated that with the present rate of production, the proposed abolition of octroi dues, should it ever be carried out, would so increase the home consumption, as to leave very little common wine for export. The heavy cost of carriage by rail, enhancing as it does, by 30 to 50 per cent. the cost of the wine sent from the Valdepenas and central districts of Spain, makes it all but impossible to market these wines abroad. The shipments of common wines show a falling off more noticeable, however, in the declared value than in the actual quantity. The 1906 figures were 28,470,000 gallons, valued at £1,890,000, against 42,218,000 gallons, valued at £3,231,000 in 1905. The exports of sherry, however, increased from 406,450 gallons in 1905, to 1,003,442 gallons in 1906, valued at £126,000 and £243,000 for the two years respectively.

MEXICAN BROMELIA FIBRE.

Among the collections of fibres from tropical America shown at exhibitions has frequently appeared a long silky vegetable fibre of a greenish colour, and showing great strength, though only an expert might particularly notice the small hanks into which the fibre is made up. When a specimen is unwrapped, however, the fineness of the fibre and its extraordinary length become apparent, for six feet is a common length. So long is the fibre that it is difficult to break even a few filaments by direct strain without cutting into the hands. According to the Bureau of the American Republics, this is produced from the long narrow leaves of a "wild pine" belonging to the genus Bromelia. The nomenclature of the species is confused, however, for the fibre has been variously labelled in the museums and at exhibitions *Bromelia sylvestris*, *Bromelia pita*, *Bromelia pinguin*, *Bromelia Karatas*, and *Karatas plumeri*. Its most common names are pita, pinuella, pinguin, and silk grass, though "pita" is meaningless, and silk grass is applied to so many other fibres that the name is worthless. The better names are pinuella and karatas. In the regions of Southern Mexico, from Oaxaca to Vera Cruz, where the plant grows in great profusion, the fibre is used largely for fine woven textures, where strength and durability are essentials, such as hunting bags and other forms of pouches. It is also used for sewing threads, and was formerly employed for sewing shoes. The fibre is cleaned by hand, and the great length of the thin narrow leaf, which is armed along its edges with sharp spines, makes it a tedious operation, hence the high price of the fibre. Efforts are being made to clean the leaves of the wild pineapple by machinery, and some fair examples of the fibre have been turned out experimentally in small quantities, so that future experiments are looked forward to with interest. The difficulty in the way of machinery extraction, is largely due to the fineness, and length, of the leaf, a machine powerful enough to scrape off the hard epidermis enclosing the fibre layer being too harsh in its action, thus injuring the fibre. The production of well cleaned, unbroken fibre by machinery, and in commercial quantities, would no doubt give to manufacturers a new textile which might enter into some of the present uses of flax, while the peculiar silkiness, and the colour of the fibre, would adapt it to the manufacture of many beautiful woven articles, such as fancy bags, and even belts for summer wear. It would doubtless make superior fishing lines, and with further preparation and bleaching, it is probable that the fibre might be employed in a wide range of woven fabrics of great beauty. An Italian authority states that in Brazil and Guiana, where a similar (if not the same) plant abounds, the fine silk fibre is manufactured into many *articles de luxe*. In an old work on Mexico a species of Bromelia is referred to, which is said to yield a very fine fibre six to eight feet long, "and from its fineness and toughness, it is said to be commonly used in belt-making work. It also finds application in the manufacture of many articles, such as bagging, waggon sheets, carpets, &c., besides being a valuable material for making nets, hammocks, cordage and many other articles in common use." This undoubtedly refers to the common form of Bromelia. A species of short-leaved Bromelia grows in Paraguay and Argentina, producing a somewhat similar fibre, which is known as Caraguata, the product of *Bromelia Argentina*. The filaments from this species are rarely longer than four feet, and while the fibre is short and strong, it does not compare with the pinuella fibre from the regions of Oaxaca, Mexico. Bromelia fibre is closely allied to the famous piña, or pineapple fibre of the Phillipines, from which are manufactured beautiful textures, such as fabrics for ball dresses, and handkerchiefs of gossamer fineness. There is said to be little doubt that with a careful preparation, some of the wild pineapple fibre might be employed in the same manner.

ARTS AND CRAFTS.

Art and Advertisement.—The First Annual Business Exhibition at Olympia would not, at first sight, appear to have very much to do with Arts and Crafts. It suggests, rather, a show of systems of filing. office furniture, typewriters and fountain pens, than of anything even remotely connected with art. And all these things, naturally, form a very important portion of the exhibition, as they do in office equipment in the present day. But, there is yet another part of modern business method advertisement—which plays a very important part nowadays, and which was, fitly enough, largely represented at the show. Nearly everything is advertised more or less, and no business exhibition would have been complete which did not include methods of advertising. Certainly the one held at Olympia did not err on the side of excluding or discouraging them; and the opportunity of showing what is being done and can be done in the way of printing for advertisement, was seized not only by the large advertising agents and poster printers, but by old-established firms connected with a very different type of work, like Messrs. Bemrose and others.

The Three-Colour Process.—We are all familiar with the strides which have been made in colour printing in recent years owing to the introduction of the three-colour process. We have grown accustomed, maybe we have even come to demand, coloured illustrations in books of various sorts; and we expect such illustrations in comparatively inexpensive books to rise to a level to which some years back the most expensively produced folios would hardly have attained. At Olympia, we had an opportunity of seeing on a large scale what a change the process had effected in the way of showcards and other advertisements. Of course, chromo-lithography is still employed, but by far the larger proportion of this kind of work is now done by the three-colour process, and done in a way which is certainly more artistically attractive than what was being done say a dozen years ago. Advertisements, it goes without saying, are primarily meant to attract, and, in nine cases out of ten, neither the advertiser nor the person who looks at his showcards, or whatever they may be, cares anything about art for its own sake; but it would seem that even from a purely commercial point of view a better (more especially if it happens to be at the same time a cheaper) process is sure to win its way to the front. This particular process, at least, has certainly caused something which amounts almost to a revolution in the domain of colour printing.

Poster Design.—In the matter of posters, again, we see very clearly how very much fashion has changed of recent years. Probably most of us have been struck by the difference between the hoardings of the present day and our youthful recollections of what such places used to look like, and have wondered at times, more or less idly, how much of the improvement in their appearance was due to the designer, and how much to the bill poster—for posters are, undoubtedly, better displayed than they were even two or three years back. In the busy streets of a large city, however, there is barely time to glance at the posters, and none to study them; at Olympia, on the contrary, it has been possible really to consider them—and to see how great a change has come over their design. It is not merely that here and there a man like Hassall has grasped what a good poster should be, but that the aim of the poster designer is essentially changed. He no longer desires to cram everything he can think of as being connected with the article he is advertising into one poster—he no longer tries to see how many different colours he can get into the same bill. He has changed all that, and seeks now rather to call attention to one fact in as simple and direct a manner as possible. It is astonishing, too, to see how many of the most successful advertisements of to-day are printed mainly in black and white, with just a dash of red and yellow, whilst nearly all the most attractive posters are printed in few colours, and are practically innocent of shading. The modern poster may often enough be far from satisfactory from the point of view of art, but it is, as a rule, a businesslike and workmanlike production enough, which is in itself something for which to be grateful. Technique without art leaves much to be desired, but art without technique is surely a contradiction in terms.

Lettering.—Another direction in which there are signs of change in advertising methods is in the way of lettering. Slanting letters, shaded more or less after the manner of old-fashioned public house signs, are with us still, and to these have been added certain modern attrocities in the way of wobbling O's, wandering S's, and other letters placed at varying angles with little or no attempt to range. There is also a certain amount of imitation handwriting and typewriting which is far from beautiful. But in spite of all these things it has to all appearances dawned upon both printers and advertisers as a whole that the surest way of making advertisements effective is to print them in simple and legible type—and that it is no use puffing so-and-so's soap or someone else's cocoa in ornate letters which leave the man in the street in some doubt as to what you are trying to push—or which, failing that, take some appreciable time to decipher. Ordinary leaflets, notices, and advertisements generally are meant to call attention to themselves and to be cursorily read. For this the two great essentials are simple, legible lettering and good spacing, and it appears that in both these matters art and advertisement can really go hand-in-hand. There are, indeed, advertisements (attractive enough in one sense) in which anything approaching to art is conspicuous by its absence—but in most cases the notices and leaflets at which anyone with any pretentions to taste is inclined to look twice, are those which are printed in a refined type and spaced

and generally set out with a certain amount of artistic feeling.

It is easy enough to rail at advertisement and natural to deplore its necessity, but since it is there it is at least encouraging to see that it is not always or increasingly vulgar or even commonplace. Certainly anyone who went to the first Business Exhibition and brought away with him a fair number of the numerous leaflets, &c, which were offered him could not fail, if he took the trouble to go through them afterwards, to be impressed with the fact that their general get-up was, in the great majority of cases, a very great deal more tasteful and more pleasing than it would have been a few years ago.

The Central School of Arts and Crafts.—Londoners have again had an opportunity of seeing the results of the year's work at the Central School of Arts and Crafts. The school has now been at work for eleven years, and has a very comprehensive curriculum. The works shown, indeed, range from architectural drawings, modelling, and stained glass work, to bookbinding, book illustration, enamelling, painting on china, and miniature painting; and there is a fair-sized collection of embroidery, lace, cabinet-making, and silversmiths' work. The standard of proficiency reached in the different classes varies very considerably, probably because in some cases the students are connected with the trades they practice, whilst in others they are amateurs. The bookbinding, if not strikingly original, shows very good workmanship. The school has always been noted for its writing and illuminating, and there seems no falling off in this respect. The stained glass painting students seem to have been encouraged to copy heads from Renaissance models, with the rather odd result that, whilst four or five of them have reproduced in glass heads from pictures by Botticelli or by Venetian artists, only one has sought his inspiration in old glass and copied the celebrated head of the Constable in the Montmorency glass. The embroidery class appears to be very popular, and a good deal of executed work is shown. There is comparatively little gold thread work or very fine silk embroidery, but the coarser kinds of embroidery and work which is done, or could be done, in the hand, are well represented. One or two of the students in this class seem to have a very good sense of colour. Some of the enamel is quite ambitious, and there is some competent silversmith's work. Quite a number of museum studies were shown; some of them of the very slightest description, others more finished, and a few designs for textiles, &c. But the designs form only a very subsidiary part of the exhibition. It would seem that the school is intended at present to turn out craftsmen with a knowledge of design rather than to train designers for manufacture. It will be interesting to see when it moves into its new quarters whether this part of its work will continue to be almost exclusively developed as it is now.

GENERAL NOTES.

Electric Lighting in Spain.—The extension of electric lighting in Spain is noticeable. In his report on the district of Bilbao, just issued (Cd. 3283) Mr. Consul Maclean says that even the villages in the interior are supplied with cheap lighting and power, being favourably situated in the vicinity of the many waterfalls which abound in the north of Spain. The Bilbao Co-operative Society increased their power last year, and now utilise four motors of 1,200 horse-power, producing 800 kilowatts. Their machinery was obtained from Swiss and German firms. La Compania Electra, in order to compete with the society, have reduced their price to fourpence per unit, and have also extended their cables to the villages and towns on both sides of the river Nervion —a distance of about nine miles—thus competing with small local companies. A Franco-Spanish company has been formed at Irun, on the frontier, for the purpose of putting up a water-driven electric plant to supply cheap power to the south of France.

Barcelona.—Barcelona seems to differentiate itself from most Spanish towns not only in its political views, but in municipal enterprise. In his report on the trade and commerce of the district (Cd 3283), Mr. Acting-Consul-General Smithers suggests that Barcelona has a more complete system of electric trams than any other city in Europe. German and Belgian companies control the whole of the many lines, the only British company having been sold to a Belgian syndicate last year. Various small extensions were made in the year under review. A German company carried a line through the Calle Muntaná, one of the principal arteries connecting the city with the neighbouring suburb of Bonanova, and the Belgian company owning the Sarria to Barcelona Electric Railway have extended their line about 1½ kilims. to the foot of the hills, and thence have built a funicular railway to the mountain village of Valvidrera. The entire journey from Barcelona to Valvidrera takes some 40 minutes, and it is not surprising that many villas for summer residence are being built in the village, which is about 1,200 feet above the level of the sea. The public lighting of the city is on an elaborate scale, and private lighting by electricity is very general, and daily becoming more so, with the result that there is plenty of work for electrical engineers and fitters, while dealers in apparatus are kept constantly employed. The authorities are doing their best to improve the condition of the provincial roads, and most of them can now be used. The only auto-mobile factory in Barcelona is a very small one, turning out about 30 cars per year, so that a large number of cars have to be imported. Mr. Smithers says this branch of trade has been neglected by British manufacturers, French machines being about the only ones seen on the road.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

MULREADY PRIZE.

The Council of the Society of Arts are prepared to offer, under the terms of the Mulready Trust, a Gold Medal, or a prize of £20, for competition amongst students of the Schools of Art of the United Kingdom, at the Annual National Competition to be held in 1908.

The prize is offered to the student who obtains the highest awards in the following subjects:—

(*a.*) A finished drawing of imperial size from the nude living model.

(*b.*) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses (mounted on not more than two imperial size mounts).

(*c.*) A set of studies of hands and feet from the living model (mounted on not more than two imperial size mounts).

(*d.*) Drawing from the life, including memory life drawing done at the Examination in May, 1908.

No student will be eligible for the award who does not pass in the Examination (*d*) in drawing from the life, and who does not obtain an award for (*a*) the finished drawing of imperial size from the nude living model. The other two subjects are optional.

The works must have been executed between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1892, 1893, 1896, or 1903, cannot compete again.

The drawings, &c., are to be submitted, with other school works, in the usual manner to the Board of Education, South Kensington, in April, 1908. Each competing drawing must be marked "In Competition for the Mulready Prize," *in addition* to being labelled according to the Regulations of the Board of Education.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ROMANESQUE ORNAMENT.*

BY F. HAMILTON JACKSON, R.B.A.
Vice-President of the Society of Decorative Designers.

Lecture I.—Delivered February 25, 1907.

I suppose each one of us has his special preferences in art matters, and in all probability holds that those forms which appeal to himself are those which are worthiest the attention of all, and, in fact, that he who does not appreciate them with an equal enthusiasm to his own is lacking in some quality necessary to the full rounding of his nature. This may generally be inferred at least from the opinions expressed in public by those who think themselves qualified to speak, and I am not sure that such heated advocacy is always disadvantageous, for it is astonishing how great an impact is required to force the British public to move even an inch or two towards the appreciation of any matter connected with art. To-night, however, I am happy in knowing that to such an audience as I have the honour of addressing there is no need to apply the spur. You are already interested in all forms of art, and eager to increase your knowledge of any one which is considered admirable, and will pardon the enthusiasm of one who thinks his subject, "Romanesque Ornament," one of the most beautiful styles the world has seen, joining, as it does, to great ingenuity of arrangement and beauty of line in the design a corresponding completeness and mastery in the use of the materials in which it is carried out, combined with a noble restraint and architectonic feeling which has often been lacking to the craftsman who possessed perfect mastery in the use of the tool.

Romanesque is a name given to a round-arched architecture which was developed from

* These lectures were fully illustrated by photographic lantern slides.

classic and Byzantine forms, and in which the principles of construction that subsequently burst forth into the full flower of scientific Gothic germinated and were developed. With the architecture we are only concerned in so far as it affects the production of ornament, but I should like to repeat that the principles which were the germs from which the splendour of Gothic architecture sprang are all to be found in Romanesque; and this indicates a mental calibre in the designers and master builders at least not at all inferior to the great names of a later date. As far as carved ornament goes (from which many of my examples will be taken) the style was at its best during the latter part of the twelfth century, lingering rather later in Germany and much later in Dalmatia, where the pointed arch was used very little. The finest examples are perhaps to be found in France, where the genius of the people for figure sculpture allowed of an earlier mingling of figure and ornament of equal excellence. In Italy and Germany the ornament is generally superior to the figure work, and the same remark applies to our own country.

To-night I propose to show examples which will prove the variety and beauty of the style in different countries, commencing with France. The tympanum of the south door of the church of St. Pierre, Moissac, ascribed by M. Marignan to the middle of the twelfth century, though M. Rupin dates it earlier, which has been thrown on the screen, is a good example of the sculpture and of a certain type of the ornament of the period in this part of France. Note the curious border made by the convolutions of a folded riband, a pattern which is common in painted decoration, treated rather more geometrically. The large rosettes upon the lintel, which is made of several pieces of a Pyrenean marble, indicating a different origin from the rest, are repeated on a fragment at Cahors, the damaged north door of the cathedral in this city shows even finer design in the central figure of the tympanum, though the subjects flanking it from the life of S. Stephen are out of scale. The best sculpture in France was produced between Angoulême and Cahors at this period. The cathedral at Autun has another example of a very fine tympanum, and in this case the surrounding ornament is of the same period, while at Moissac the setting is of a somewhat later date. This gains further interest from its being a nearly exact copy of that executed at Vézélay a few years earlier except for the pose of the principal figure, and from its being the earliest French instance of the sculptor signing his name. "Gislebertus me fecit" is found in the centre of the band of inscription, 1150. The subject is no longer a Majesty, but the Last Judgment, with the weighing of souls and separation of the sheep from the goats, which is frequently met with on Gothic tympana. The border of signs of the zodiac and labours of the months is simply a repetition of the corresponding portion at Vézélay. In these carvings you will observe a strong Byzantine influence in the treatment of the drapery, and a conventionality which is only beginning to yield to the study of nature, and there is little doubt that the school of Toulouse, the earliest and least accomplished of the French schools of sculpture, so far as its earlier works are concerned, found inspiration in copying Byzantine ivories. The early reliefs of apostles in the cloister at Moissac, preserved from the building of Abbot Ansquetil, destroyed in the fire of 1188, show soft modelling and deeply-cut outlines to force it up, as do the somewhat similar reliefs encrusted in the wall of the choir of S. Sernin, Toulouse, which probably formed part of the decoration of the ancient cloister there. At that time the only provinces of Gaul which had preserved any traditions of antique art were those in which the Roman municipal organisation was still maintained. Several towns of the south governed themselves *intra muros* as under the empire, and therefore retained their bodies of artisans and traditions of the art of antiquity though much dulled. Toulouse was the city which had best preserved its municipal organisation and the practice of the arts had been continuous within its walls. It became, as might be expected, the centre of a powerful school, the influence of which was widely spread. Arles and S. Gilles show its influence in the modification of the classical tradition. The pattern upon the cap to the left of the two now on the screen, from the triforium of S. Sernin, shows forms which are almost exactly reproduced in the beautiful capital to the right of the two from the cloister of Moissac.

Beneath the tympanum at Moissac which we were looking at just now is a very remarkable piece of sculpture, the central pier. It is the work of a man of genius and shows a curious mixture of influences. The pose and interweaving of the lionesses have been held to suggest a northern origin, which the method of using the tool and rendering detail contradict,

while the figures of the prophets at each side recall figures which one has seen in Italy, but with a greater feeling for grace and completeness in the rendering of form.

Here also the influence of Byzantine design is very evident, specially in the arrangement and treatment of the hair and the flow of the draperies, mixed with apparent study of nature. M. Rupin says it bears the date 1100 and the name Asquilinus. In the museum at Burgos in Spain is an Arab casket of the eleventh century from the monastery of Silos in which this detail of the crossed lions occurs among hunting scenes, stags, and animals resembling Assyrian monsters, which may be traced still further back on a Sassanian vase in the Cabinet des Medailles at Paris, and on Assyrian cylinders, and is plainly one of those Oriental features which were found so inspiring by the ornamentalists of the south of France. In the narthex (which is generally given a rather early date and has an interesting attempt to solve the problem of the junction of vaulting ribs) the caps are carved with beasts in somewhat the same manner, though of a different stone, and the lioness to the right clearly shows her near relationship to the finer animals on the pier.

It is a matter still disputed by French archæologists whether the beautiful doorways with architectonic figures attached to the columns of the jambs were an invention of the South, of the west, or of the northern part of France, some holding that the Provençal School influenced the sculptors of Chartres, though this is very doubtful, regard being had to the several dates; some that the sculptures at Le Mans were the earliest, and some that they first were used by Abbot Suger at St. Denis. Unfortunately, the door which we know that he finished in 1140 no longer exists; the dates of many of the existing examples are matters of deduction rather than proof, and the question is complicated by the probability of earlier carvings having been used up at a later date, as was certainly the case in some of the Italian buildings. Take the beautiful west portal at Chartres, for example, probably erected as a porch between 1150 and 1175. It is evident from the difference of height in the figures, from the change from time to time in the patterns of the intervening portions, and from the fact that some figures have canopies and others none, &c., that if the various parts are contemporary and all made for the same piece of work, the sculptors had so much liberty as to amount to license. You will observe that the pattern sometimes changes with each fresh piece of stone, showing that the carving was done before the stone was put in place, while sometimes the design runs through several courses unchanged; and when it is remembered that no less than three foundations for the western walls exist in different parts of the nave, showing two re-buildings, and that there was a destructive fire in 1194, after which the cathedral was entirely re-built, I am sure that you will realise that the problem of the exact date of execution of any part is a difficult one. But how beautiful it all is! The majestic figures aiding the stability of the design by the lines of their composition, while the variety of pattern, the excellence of carving and ingenious composition of line in the ornament between is beyond all praise. The tympanum of the central door is especially fine in composition, showing the usual subject on that part of the doors of the Romanesque period in the north of Europe, Christ in glory, surrounded by the symbols of the evangelists. Doorways of this type of varying degrees of excellence are to be found at Le Mans, Bourges, Étampes, and other smaller churches, and records of their previous existence in several towns where they are no longer to be seen, as well as in other countries.

In Provence, which was the favoured province of the Roman empire from B.C. 150 till about 450 A.D., and was the first of the Roman Transalpine establishments, sculpture is treated differently, the Gallo-Roman tradition being stronger and the remains of antique sculpture of more frequent occurrence; indeed, at Arles, as also at Vienne, the carving of sarcophagi continued till the close of the sixth century, if not later. It has retained the name given it—Provincia, the province. The ancient kingdom of Arles was separated from the empire of Charlemagne in 879 by the marriage of Hermengarde, daughter of Louis le Debonnaire with Bozon, Count of Ardennes. At the close of the eleventh century the marriage of the heiress of Provence united her possessions with those of the Count of Catalonia, and various portions of Northern Spain and Southern France were ruled by the same lords during a great part of the Middle Ages. The Spanish royal hero, Jaime el Conquistador, was born at Narbonne, which had been the residence of Visigothic kings, and, for forty-two years of the eighth century, of Arab Sultans. The courts of their Spanish lords were frequented by the minstrels of Provence, and from the Arabian settlers

of the Peninsula they derived the ornament of rhyme, the form of their verses, the character of their poetry, and that superior intellectual culture which for three successive centuries made their language and poetry the admiration of Christian Europe. And where this influence affected literatnre, similarly ornamental art was benefited, though this was only one of the ways by which Oriental forms entered into the repertory of the designer. The Provençals were the natural intermediaries between France and the Crusaders established in Syria, and the church of St. Trophime, Arles, the façade of which is the best-known example of Provençal sculpture, elaborately carved with figures and ornament, in its general proportions and profiles is based on the same lines as many of the churches of Syria which the Crusaders saw between Antioch and Aleppo. It must be remembered that Antioch was in Western hands from 1098 to 1268. The sculpture, however, follows the Gallo-Roman tradition in the main, though affected by Byzantine carvings which were part of the commercial products continually arriving from Constantinople, such as costly covers of books or diptychs, ornamental furniture, and the splendid textiles which were for the ornamentist a still more fruitful field of suggestion. The generally received opinion is that this façade was built late in the twelfth century, or even at the beginning of the thirteenth, as some contend, but certain irregularities in the arrangement of the figures suggest alterations, and it is precisely in those parts that the detail of costume occurs which is relied on, perhaps insecurely, for fixing the later date; the shape of the mitre of St. Trophime in the centre panel of the five. In the cloister is the mortuary inscription of a master builder, Pons Rebolli, with the date 1183, who was priest and canon regular and also operarius of the church as the inscription states, proving that work was going on shortly before that time, though the epitaph of Pons de Bascle, regular canon, gives the earlier date of 1165. The iconography of the whole is much upon the usual lines. Christ in glory, crowned as at Moissac, with the evangelistic beasts in the tympanum, half lengths of angels below and prophets and apostles on the lintel. A fresh detail is the row of the blessed led to heaven in close order on one side, an angel handing their souls to Abraham, and the damned in charge of demons walking through flames on the other, which form a frieze above the row of colonnettes.

The church at S. Gilles is a still finer example of the same style, which shows the influence of the antique to an even greater degree in the figure sculpture, and in much of the ornament, while in certain details the copying of *motifs* taken from Oriental textiles is equally apparent. This town was one of the principal ports at which the Crusaders embarked during the earlier period of those wars, and was very prosperous, with a flourishing commerce and many rich merchants. The church was commenced in 1116, and the façade is probably of 1140 as regards the main portion, the Albigensian wars and other difficulties, as at Toulouse, stopping the artistic development of the country and sapping its prosperity. It is thought by some that the design was at first arranged as at S. Trophime and that the side doors are a later addition, but the mouldings and the carved ornaments are quite similar on the archivolts and abaci of all three doors, and though the central door shows signs of change in design, those at the sides are consistent throughout.

It is curious that the most celebrated piece of Poitevin architectural sculpture, the façade of Notre Dame la Grande, Poitiers, has characteristics which are more closely connected with the art of Saintonge and Angoumois than with Poitiers itself. The conical pyramids with which the turrets at each side of the façade terminate, as does the central tower, are distinctive features of the Romanesque buildings of Saintonge, and are also found at Perigueux, and the lavish decoration of the archivolts is also not uncommon at Saintes and in the vicinity. The imagination of the sculptor has run riot over the whole surface of the façade, and a general richness of ornamental effect compensates for a certain inferiority in the style of the figure sculpture. Whether the incursions of the Northmen left behind a liking for northern savagery with a predisposition to quaintness in the treatment of animal form is a debateable point, but certainly there is a good deal of grotesquerie in the details of some of the archivolts, as in the dogs which surround this arch on the right, and the character of the ornament is very different from that of Provence. You will notice that each stone of the arch has a completed unit of design upon it, so that as the stones narrow or widen the design varies in its lines though apparently intended to be a repeating pattern. The same thing may be observed in the simpler Norman patterns, of which examples may be seen

much nearer home, as, for instance, at New Shoreham. This façade was added in the twelfth century to an eleventh century building and touches a point beyond which richness can scarcely go, and one hardly likes to think of what the original effect must have been when the stone was painted and gilded! The arcades are filled with statues of the twelve apostles with two bishops thrown in, perhaps SS. Martin and Hilary, and below the string course the spandrils are also decorated with carving, the subjects being Adam and Eve, Nebuchadnezzar, a group of prophets with scrolls, Moses, Jeremiah, Isaiah and Daniel, the Annunciation, Jesse with the tree commencing to grow from him, the Visitation, the Nativity, &c. The little arches below the string are all filled with carvings, and elaborate patterns decorate the arch mouldings, while the ground of the gable, in the centre of which Christ stands in glory within a mandorla is patterned by the shapes of the facing stones of which it is constructed.

The Church of S. John Montierneuf (a corruption of *monasterium novum*) shows in the poor remains of its central tower the same kind of design as Notre Dame la Grande, which was probably due to the same architect, a monk named Pons. It was founded in 1075, and consecrated by Urban II. in 1096, on his way from Clermont, where he had been preaching a crusade. It still retains a wall arcade round the apse of the original building. Here you see a less-developed form of the intertwining stems and leaves characteristic of the later Romanesque, and I have selected a grotesque also from the caps of this arcade, which shows a mode of avoiding the awkwardness of two animals' bodies meeting at the angle, where the volute would naturally be, having only one head between them. The founder of the monastery, Count Guillaume Guy-Geoffroy, used to visit the monks every day when he was at Poitiers, and after his death they still set his place at each meal to keep his memory green. The tower of S. Porchaire is of 1068, and shows in its walling a reminiscence of the Roman *opus reticulatum*, which may be held to connect it with the external inlays of Auvergne, though there is no variation of colour. The church is an instance of the reputation of the saint who was buried within it, replacing the original dedication as at S. Hilaire and S. Radegonde, both of which churches originally bore different names. The caps at the door of entrance are carved with quaint devices of an Oriental derivation—a common symbolic subject is Daniel in the lion's den, typifying the Christian amid the temptations and troubles of the world. Here we have the lions without Daniel, but with a central tree upon one, perhaps typifying the abbatial jurisdiction, exercised "inter leones," and two birds drinking from a vase on the other. The Church of S. Hilaire is an exceedingly interesting building, though it has suffered so much from restoration that it is difficult to make sure of the age of the different parts which have been smartened up. It has been many times burnt, and a drawing in the public library, made in 1804, shows that the nave vaults were all down then. It has curious octagonal domes over the nave like those at Le Puy, which may have been copied from that cathedral, since we know that the monks rescued the relics of S. Hilary from the flames of one of the Norman incursions in the ninth century and took them to Le Puy. The carving of the caps appears to be of the eleventh century and belongs to the church re-built and enlarged by the Burgundian Countess Agnes in the middle of that century. Among much rough stone-cutting some finely designed subjects occur. The Burgundians have always been good carvers, the character of the native limestone assisting their development, and it is possible that the Countess may have imported some sculptors to assist in the decoration of her new church. Socrates tells us (lib. 7, cap. 30) that the Burgundians, in his day, were workers in wood, and so gained their living, and in the crypt of S. Benigne, Dijon, is a very curious cap which was built into the eleventh century wall, and is therefore considered to be earlier, which bears monsters and interlacings on its sides resembling Scandinavian work.

At Le Puy, which is a Gallo-Roman town, is an early cloister which Viollet-le-Duc held to be the earliest in France. It has, unfortunately, been thoroughly restored, as has the whole cathedral, with considerable alterations, but a good deal of fine ornament may still be seen. The oldest portion of the cloister appears to belong to the eleventh century, the rest to the twelfth. The walk adjacent to the cathedral was entirely rebuilt when the restoration took place between 1850-57, but the other sides were only repaired. The south-east porch is a fine and original conception, probably built at the end of the twelfth century, and showing an entirely different type of ornament to that at Poitiers, very much more

closely derived from antique forms, but with a suggestion of Arab influence in certain details. and in the shape of the bounding lines of the caps. Observe, too, the curious colonnette to the left, which reminds one of our Saxon turned baluster shafts. A triangular tympanum crowns a door beneath the porch, and bears an inscription of the fifth century, and the pattern of opposed S's—perhaps an ancient symbol suggesting fecundity—which surrounds the arch was also found on some fragments belonging to an earlier church which were excavated on the site. Cattaneo figures a fragment with a similar pattern from S. Maria in Valle, Cividale, among the work of the eighth and ninth centuries, in which that chapel is so rich. This pattern of cap from the cloister shows Burgundian influence, while the lava inlays on the wall surface may possibly have been imitated from the marquetry of wood and ivory of some imported Eastern furniture, or perhaps a development of the Roman *opus reticulatum* in colour. Another type of capital is a rough copy of a sixth century motif which occurs in several places in Italy, but of which a variant in the Cathedral of Parenzo is so near that a comparison of the two suggests a struggle on the part of the sculptor to render in an intractable material the ornament which the marble allowed to be carved with some approach to perfection. Here is another example of figure work upon the further cap. The cutting of the stone is quite adequate, though the figures terminate with the knees, and the nearest cap shows fully developed patterns resembling these we have seen at Moissac and Toulouse. In the cathedral itself are some exceedingly fine capitals, unfortunately, as at Autun, at too great a height for satisfactory photography, but these twin columns from the south transept show characteristic ornament, with the same division into two stages as occurs in the cloister and a running pattern of conventional foliage in the lower, while in the further one well-carved heads of men and animals take the place of the usual flower. The bands surrounding the stems betray a metal original for the ornament. From the Rocher Corneille, which is crowned by the colossal statue of the Virgin which you saw in the general view of the cloister, an excellent idea of the arrangement of the cathedral and its surrounding buildings may be obtained. The little cloister is sunken between the building with the twelfth century chimney (to which a fireplace belongs within) and the Hotel Dieu, to which battlements were added at a later date. The ornamental inlays of lava, and the cupola at the crossing, which are such prominent features of the churches of Auvergne, are well seen.

On an isolated rock to the north-west of the cathedral stands the little chapel of S. Michel d'Aiguilhe, looking almost as if it had come out of a mediæval picture. There was an oratory here in the tenth century, but most of the work dates from a couple of centuries later. It has a very fine doorway, unfortunately a good deal restored, which may be taken as typical of the twelfth century carving of this part of the country. Its decoration combines rough inlaid pattern, the architectural arrangement of the carving, some figure work, and much excellent ornament with a decided Oriental feeling about it. A spandril at Ani, in Armenia, shows almost exactly the same forms as the scrolls in the spandrils of the trefoiled arch. The interior has been very little meddled with beyond an endeavour to clean the whitewash from the walls, when three series of decorations were found one above the other. It has a good many interesting caps, which show what some of those in the cloister were like before they were recut, while others which appear to be only commenced recall examples in Italy, one side of which is roughed out like these, while on the other detail has been carried further, in evident imitation of the antique acanthus foliage, of which one in the crypt of St. Miniato, Florence, may be instanced. I should like to call your attention to the very beautiful cap, with the Byzantine motif of the plant springing from the vase and with similar foliage on the abacus, which seems to me a very graceful treatment. A rather late doorway at St. Lazare, Avalon, may be taken as an example of the great richness which French Romanesque so often shows. The archivolts are covered with ornament upon every member, and the jambs have a series of columns with carving between which stand upon a very high base also richly carved with ornament and subjects. The shafts, which now are plain, almost certainly had figures affixed to them, as at Chartres, one of which has been found in the belfry, where it was used as the mullion of a window. The curious carving of chain mail upon a twisting shaft shows that even at this time the craftsman sometimes selected unsuitable ornament, but the whole effect must have been exceedingly splendid when the façade possessed its three

portals, one of which has been entirely rebuilt, while the central door has been much altered. Observe the reappearance of the folded riband pattern seen at Moissac, and a sensation of clasical forms.

It seems difficult to surpass these French examples in richness, but the next slide, from the catheral of Traù, in Dalmatia, shows that it is not impossible. This is a rather late example, and shows traces of Gothic and even early Renaissance detail, but it is Romanesque in its general arrangement. It was carved by a Slav sculptor named Raduanus, in 1240, with extraordinary mastery over the material in all the ornamental portions, though the large figures of Adam and Eve show the usual failure in the treatment of the figure. On the smaller scale of those among the arabesques, however, they may pass muster without attracting attention by their inadequacy, and the lions are decorative, though not much like the living animal. They stand on brackets, and a similar arrangement is met with in Bari and some other of the Apulian towns. The turbans upon some of the caryatid figures, one of which has an expressive face, show contact with Turks or other Orientals, a feature which again occurs in the towns on the other side of the Adriatic.

Not far from Traù is Spalato, the city which occupies the palace of Diocletian, and here a very talented carver named Guvina worked in the early part of the thirteenth century, making the doors of the cathedral in 1214, and probably also the very original choir stalls. The running pattern which divides the panels of the doors has all the characteristics of the earlier Romanesque ornament of Italy and Germany, beasts and birds occupy the scrolls, hunters pursue animals through them, and curious half figures emerge from the leaf terminations. The figure work is less inadequate than usual, perhaps owing to the later date, but certain Byzantine details betray a probable copying of ivories. The stalls show a great mixture of styles in the details, an Eastern influence in the open work which resembles the Cairene musharabiyehs, a Lombard influence in the rows of arcading, while the scroll work is Romanesque, the figures looking rather later, and the interlaced patterns appear to be a survival of those which were common in the ninth century. The camel in the square panel just above the seat shows that he, like Raduanus at Traù, had had direct contact with the East. There was a school of architectural carvers here who worked up and down the coast. The pulpit in the cathedral, a very beautiful piece of design and carving, has its almost exact counterpart at Traù, somewhat simplified. Here, as you see, we have a rather rich arcading surrounding a hexagonal pulpit with carved cornice and string, the spandrils of the arches below also having a delicate flat ornament. It is supported on six octagonal colonnettes having elaborately carved caps with long necked monsters twisting and writhing among the foliage. The caps at Traù are carved with something the same kind of design but with a suspicion of Oriental feeling in the foliage, which suggests metal, while the caps at Spalato suggest wood as the material in which the artist conceived his work. In Apulia there are several caps existing, fragments of destroyed ciboria for the most part, which have a good deal of the same character as these. The pulpit at Traù is octagonal with an arcade of two arches on each face and much less carving, the columns upon which it is supported are of precious marbles and circular in section, and the patina of age which harmonizes all the details suggests to the mind a recollection of that most harmonious of all buildings, S. Mark's, Venice. Here is also a ciborium of a pattern which is considered to have been evolved by the Roman marble workers (though the example earliest in date appears to be that in the church of S. Nicola, Bari), since there are quite a number in and around Rome. The proportions of this example more nearly approach that at Bari, and it is probable that it is founded upon it rather than upon the Roman ciboria, but the type is found again as far away as Cattaro, in the church of S. Trifone, but with loftier proportions and with more carving which rather damages the effect. These are both of them comparatively late examples and show how the style lingered in Dalmatia.

Instances have been given in which Oriental costumes and details prove contact between the East and the West, but Oriental influence was felt at a very early period. In France especially it can be recognized before the Christian era, Egyptian and Egypto-Greek objects finding their way by the usual trade routes even as far as the Low Countries, probably from Alexandria. After the arrival of the Goths Syrian influence becomes more evident. The Museum at Arles proves an active centre there for Sarcophagi copied from Roman works, but by its side another was formed in close relation with Ravenna and the

East. Examples both at Arles and Toulouse prove their co-existence till the end of the sixth century. Numerous Syrians were in France from the earliest times of the empire and the first Gallo-Roman churches were probably founded by Oriental emigrants, a mixed population among whom Jews and Greeks with the Syrians were in the majority. The "Vita Hilarii" mentions Jews at Worms, Cologne, Metz and Poitiers, and there were many at Arles. Other MSS. prove that the Syrians were everywhere and possessed of a good deal of power. Gregory of Tours shows them to us very rich and possessing objects of art. Inscriptions show the early presence of Greeks at Lyons, Bésançon, Trèves, Vienne, Narbonne, and Arles, and Councils also prove their presence in Gaul. Relics of Oriental saints were brought Westward in reliquaries which gave the suggestion of such ornament as appears at St. Jean, Poitiers. As for the Syrians, in the sixth century the most active of the Christian races, St. Jerome says that in his time they were everywhere, and that trade was in their hands. Many of them were of the labouring classes; they were gardeners, and through their means the West gained several of its fruit trees; were artisans, mosaicists, and sculptors; they exported industrial objects, such as glass, silk, leather, &c. Contemporary authors show these Syrians to us in all the maritime towns. At Orleans they formed a powerful colony, and at Paris one of them named Eusebius, in 591, bought the Episcopate by profuse presents, and soon gave to his countrymen the administration of the bishopric. It was by means of the Syrian colonies that the ideas and legends of the East were spread in the Middle Ages, and M. Courajod used to say that it was impossible to exaggerate their importance in the development of design. The biography of St. Columba, by Jonas, monk of Bobbio, shows an affinity of doctrine, of sympathies and beliefs, between the Syrians and the Irish and Anglo-Saxons, which is evident also in their art.

The principal French towns for the exchange of the merchandise of the Levant and Constantinople were Marseilles, Narbonne, and Arles, as in Roman times. The maritime towns of Provence and Languedoc had in the twelfth century, both in the kingdom of Jerusalem and at Constantinople, commercial establishments, and mooring places on the quays. Provençals had a church and a quarter at S. Jean d'Acre, while the Narbonnais traded specially with Egypt. The principal Italian commercial towns also had their quarters similarly. Among the ivories imported from Alexandria are the six which decorate the side panels of the pulpit at Aachen, given by Henry II. Dr. Strzygowski has proved that these have the characteristics of the Coptic form of Syro-Greek art; and the chair of Maximian, at Ravenna, an earlier and finer example of ivory carving, has also a very decided Syrian character, though whether it was carved at Antioch, as he thinks, or in Alexandria or Constantinople, appears doubtful. The textiles with hunting scenes in medallions, or beasts, birds, or monsters face to face, of which fragments remain here and there in Western Europe, as at Aachen, Chinon, Toulouse, Sens, Le Mans, and Durham, as well as in museums, are either Byzantine copies of motifs of Sassanian origin or Sassanian originals, and an example has been discovered in Japan quite plainly based upon these patterns, which shows that their influence spread eastwards as well as westwards. The patterns carved on Eastern ivory caskets or oliphants, in which relics were sometimes brought to Western Europe, with a similar motif also had their effect, such as the Soltikoff horn, a work of the eleventh century, which, if not carved in the East, was copied from an Oriental ivory, the similar horns in the museums of Toulouse and Le Puy, &c. In these ivories the suggestion of Romanesque subject and pattern is unmistakeable.

The pillars of S. Saba, in the Piazzetta, Venice, were brought from S. Jean d'Acre, as the sequel to disputes with the Genoese, they having formed the gate to the castle opposite the church of S. Saba. The patterns upon the sides are very characteristic, vine leaves and bunches of grapes issuing from a vase and controlled to a strict conventionalism in their growth and the spaces which they fill. Upon the upper edge of the pier is a fret with slanting sides, a peculiarity which is found in Celtic interwoven patterns. In this sarcophagus from San Lorenzo, Milan, you may see absolutely the same conventions in the central panel, and they occur also at Ravenna, Ancona, and elsewhere upon the slabs of ambos and chancel enclosures. The archivolt of the Foscherari Monument, in the Piazza S. Domenico, Bologna, made of a portion of an eighth or ninth century ciborium, and much resembling the baptistery at Cividale, has a running pattern derived from Syria, which frequently occurs, with a varying number of leaflets, supporting the ball in the centre. At Castel

S. Elia, near Nepi, is a slab with this Syrian pattern having five leaflets. It occurs at Ravenna, in fragments in the museum, and may be seen as a pierced ornament on the bronze horse-trappings from the tomb of a Gaulish warrior in the British Museum. The ivory covers of a book in the Treasury at Monza have, on one of them, a pattern in which the leaf forms are more defined, two filling the circle, as on the tomb of Theodata at Pavia,

FIG. 1.

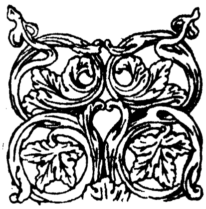


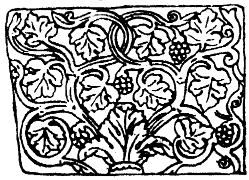
FIG. 2.

IVORY FROM THE CATHEDRAL, TOURNAI.

with a creature within, whilst the other has a beautiful pierced repeating pattern, recalling carvings of the ninth century at Como, Milan, and Rome. In the Treasury there is also a comb of ivory, ornamented with filagree and jewels. A comb of a similar shape but without the enrichments was found in 1771 on Barham Down, near Canterbury. The one at Monza is said to have belonged to the Lombard Queen Theodelinda. In the Museum at Cairo is a fragment of ivory carving, in which the vine appears springing from a vase in true Byzantine fashion with birds about the branches, which Dr. Strzygowski considers to be Syrian. The arrangement of this is a good deal like the outside of the Ormside cup of which I shall show you a drawing in connection with the Anglian crosses. Leaves of somewhat the same kind occur on the panel carved so well in the tenth century by Tutilo at S. Gall, in which he closely imitated the character of the older Italian work, to which he added the subjects of the Assumption of the Virgin and the legend of S. Gall; and an ivory in the Cathedral of Tournai has leaves and stems arranged in much the same manner (Figs. 1 and 2). A sarcophagus found in the cemetery of S. Saturnin, Bordeaux, dating from the sixth century, shows something of the same treatment, though rather freer in the underlying lines (Fig. 3); and, no doubt, in all these cases a traditional mode of filling a panel with vine leaves and fruit was followed. A version of this treatment of the leaf may be seen in another piece of sixth century work, a capital in the Cathedral Parenzo, imported from Constantinople. Mr. Butler says that in the Haurân the grape vine is the most common motif in the pre-Roman and classic carvings, and that in Christian carvings of the North of Syria it is almost the only motif used, but with a tendency to a severe conventionality; and that if animal forms were introduced, they were subjected to an equally severe symmetrical conventional arrangement.

Recent researches by Dr. Strzygowski also seem to prove a direct influence of Syrian art upon the West. In an early Evangeliar which he studied at Etchmiadzin, in Armenia, he found some Syrian miniatures of the sixth century inserted, which he holds to prove that it was customary to export miniatures from Syria. Charlemagne, shortly before his death, had a recension of the Gospels made, with the help of both Greeks and Syrians. This may explain the curious pavilions in the Godescalc and Soissons MSS., which are unlike any Western architecture, but much resemble one of the Syrian miniatures, as well as the arcading beneath which the Eusebian canons are set, which are equally similar, and of which the sixth century Syrian MS. of Rabula shows another example, with horseshoe arches. The resemblances between the school of Egbert of Trèves and Syro-Egyptian art may be traced back to the same source or may be the result of importations from Alexandria.

FIG. 3.



PANEL FROM SARCOPHAGUS, BORDEAUX.

The fine ivory in the Louvre, showing Constantine as the hero of the faith, or Justinian, which Dr. Strzygowski believes to be Alexandrian, like the reliefs on the ambo at Aachen, belonged to a Rhenish church in the middle of the seventh century, probably to Trèves Cathedral. On its back it has 350 names of believers, arranged in six columns, many of which belong to the Rhine and the diocese, names of archbishops between the fourth and

the seventh centuries, and of others sprung from Trèves. At the end of the fifth column names of Kings of Austrasia occur, from the second half of the sixth to the middle of the seventh century—Heldebert, Theudebert, Theuderic, Clothair, Sygisbert, Childebert, Athanagild, Fachileuva, Inganda. At Wolfsheim, near Mainz, in 1869 or 1870, a jewel was found which had probably formed part of a girdle. It was encrusted with jacinths and garnets, or red glass, and had upon it the name Artaxerxes in Pehlevi, the form of the letters making it probable that the first of that name was the person referred to. The discovery was of great interest as showing that the particular form of decoration of jewellery was practised in Persia in the third century, and also that there was direct communication between that country and Germany during the early Middle Ages.

In England we know the Romanesque as the Norman style, and the architectural ornament has not in general the variety and fancy which characterise the Continental Romanesque. Bishop Stubbs says the Norman brought little in comparison with what he destroyed, and little that he brought was his own! Late examples are sometimes florid, as the fine door at Kilpeck, Herefordshire, the prior's door at Ely, and the door at Barfreston, near Canterbury. Decoration was generally focussed round the doorway, which frequently had four or five recessed orders, with shafts and carved members between. Examples may be seen at Lincoln, where the house of Aaron, the Jew, has the door beneath the projection of fireplace and chimney on the first floor; also a fine doorway may be seen in the cathedral; at Iffley, Durham, Malmesbury, St. Peter's, Northampton, Kenilworth, the College Gateway, Bristol, St. Margaret's at Cliffe, and many other churches; and other ornamental features at Romsey, Tewkesbury, Glastonbury, Exeter, Norwich, Worcester, Gloucester, Castle Rising, Rochester, S. Cross Winchester, the Galilee at Durham, &c. Prior Ernulf used interlacing arcades as a wall decoration on the outside of the cathedral, Canterbury, about 1110, and repeated them at Rochester a few years later when he became bishop. Here also the mutilated figures of Henry I. and Queen Maud or Edith show that the portals of Chartres and S. Denis had their influence in the South of England, but for the most part the figure sculpture is barbarous, though the monsters and animals show a quaint fancy; and the ornament is confined to the repetition of a few forms, of which the chequer, the billet, the zigzag, single or double, and an allied form like heraldic engrailing, the nailhead, chip carving patterns, the besant, beak-heads, and interlaced arches occur most frequently. The patterns from Behioh and Safa, in Syria (Figs. 4 and 5), show that some of these forms occur in sixth century Syrian work, and scrolls like those of the church at Behioh, with winged cherubs of an Oriental type occur on the Shrine of S. Mummolus at St. Benoit-sur-Loire (678-85). Capitals are sometimes scalloped or gadrooned when on circular piers, and a kind of cushion cap like a ball with slices cut off perpendicularly is common; these freqently had ornament painted on them. The carved caps often suggest initials of MSS. with animal forms, the

FIG. 4.

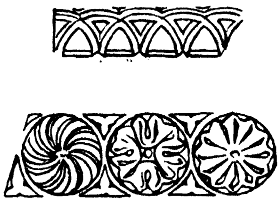


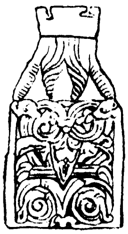
FIG. 5.

SYRIAN PATTERNS FROM BEHIOH AND SAFA.

interlacings treated flatly with scales and pearlings. On smaller objects, however, we often find beautiful and elaborate work. Examples of chessmen in the British Museum and at Oxford in the Ashmolean show considerable vigour of conception and carefully arranged ornament, as on the backs and sides of the chairs in the chessmen in the British Museum (Fig. 6). Here, too, is a very fine example of an eleventh century Tau cross of ivory belonging to a bishop's crozier which is both finer in design and workmanship than the one in the Musée Cluny found in the tomb of Abbot Morard at S. Germain des Prés and dating from the same period (Fig. 7). An earlier one is in the museum at Rouen which came from the abbey at Fécamp (Fig. 8). The drawings will show that the date of ninth or tenth century which has been suggested for this work is too early.

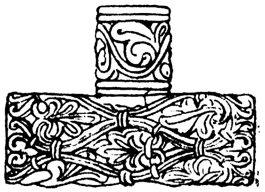
Some of the twenty-five lead fonts scattered up and down the country, most of them in the south, are Norman in design, as are a good many of those worked in stone, of which two very fine examples in Norfolk may be mentioned, at Toftrees and Shernborne, but those which are perhaps most typically Romanesque in appearance, such as those at Lincoln and Winchester cathedrals, which, as well as that at S. Nicholas, Brighton, are decorated with subjects from the life of S. Nicholas on some of the faces, and with roundels containing birds and monsters on the others, and made of black marble, were imported from Tournai ready carved, and are not English at all. There are seven in England, six in France, and three in Belgium itself. There are sepulchral slabs of the same material and workmanship at Bridlington and Ely. A very fine font, carved with different patterns on each of the four sides, and signed by the sculptor Robert of Durham, still exists at Bridekirk.

Fig. 6.



Back of Chessman, British Museum.

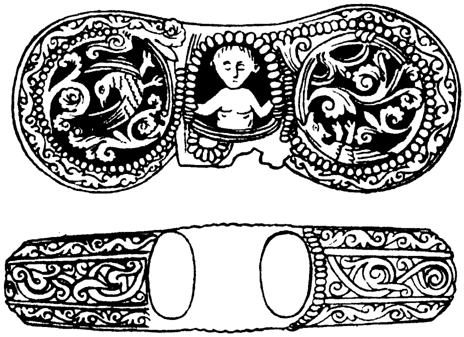
Fig. 7.



Tau from Tomb of Abbot Morard, Musée Cluny.

At Durham, the sanctuary-ring still hangs from the door, though the monster has lost his eyes of crystal. It is so much like a door-ring at Le Puy that it has been ascribed to the same smith, which seems improbable. The MSS. do not show any great advance upon those executed before the Conquest either in ornament or in figure work. The zigzag is a very ancient pattern; the earliest instances of its occurrence being prehistoric. It is found on vases from the tombs of Cnossos, on archaic pottery from Camiros, and on an Etruscan ossuary from Vetulonia of the second or third century B.C. On a piece of prehistoric pottery found in a tomb with a flint arrowhead, impressions of the arrowhead were so arranged as to produce a zigzag, tempting one to suggest this origin for the ornament. Its earliest use as architectural ornament is, I believe, on the modillions above a door at Spalato. Other of the characteristic ornaments have an Eastern derivation, such as the rosettes and besants, others from ease of production, as the nailhead and dentil, while the beakheads are probably Scandinavian, though they have a barbaric appearance which reminds one of Polynesia and New Zealand. In Sicily the Norman influence in ornament shows very little. At Cefalù there is an interlaced chevroned arcading on the façade. At Girgenti the door of the ruined church of S. Giorgio and the great window of the fourteenth century campanile (both with pointed arches) have the familiar zigzag, and at Bivona the same details occur, while the door of Santo Carcere, Catania, which belonged to the ancient cathedral, has round arches with columns in the recessed jambs and some carving of the twelfth century. Mr. Phené Spiers has informed me that two doors of one of the Cairene mosques bear decoration of

Fig. 8.



Early Tau from the Museum, Rouen.

Sicilian origin, one having the Norman zigzag and the other the cushion voussoir, which appears to be a Sicilian invention, though it is found in the church of the Holy Sepulchre, built by the Crusaders after the taking of Jerusalem in 1100. The usage of cushion voussoirs was carried back to France, and they occur in the abbey church of Évron (1150-75), the central window of the apse of Marolles-en-Brie, the doors of the churches of Chivy, and S. Pierre at Soissons, of Bellegarde, Plassac and Marignac, in the chapel of S. Gilles at Pons, and the tower of La Croix, Aisne. The strangest use of the zigzag with which I am acquainted is on two caps in S. Mark's, Venice, which are surrounded with the ornament on a large scale with a very odd effect, and the occurrence of two precisely similar in the mosque at Kairouan suggests that they are importations from the East.

In Scandinavia an exceedingly elaborate

ornamentation was developed at a rather late date, based upon the Romanesque intertwining scrolls, which was applied principally to the decoration of the doors of churches, as in the instance from Hallingdal, although also applied in a modified form to furniture and to caskets. The caskets are sometimes of bone and sometimes of wood; the rest of the work is executed in wood, often enriched with colour. Heathen symbols and incidents occur mixed with Christian, but it is pretty well established that most of the work is as late as the thirteenth century, though the Norsemen became Christians in the eleventh. From the ninth century onward they habitually robbed Western lands, and carried costly objects home with them. It appears, therefore, that these patterns are imitations or developments from Irish jewellery, &c., though some influence from the Continent is possible. Discoveries of Oriental coins in the North prove that exchange between Scandinavia and the East began after the fall of the Sassanian power, but relations became closer in the ninth and tenth centuries, to which periods thousands of Cufic coins which have been found belong.

The Gothic and later Romanesque architecture of Spain is largely influenced from France. The cloister, Tarragona, for instance, resembles that of Fontfroide, but this is not the case with the churches of the ninth century, though the South of France and Spain were ruled by the same Visigothic kings at an early date. Leovigild, who began to reign in 572, united Gallia Narbonensis to the Iberian Peninsula, and extended his rule to the Straits of Gibraltar. Recared, his successor, established his Court at Toledo. A king of Leon, Froila II. (923-4), founded an "obit" at S. Martial, Limoges, and in the obituary of the convent mention is made of two nuns, sisters of the "king of Spain" (whatever that may mean), Vrraca and Aibelis. Moorish spoils were brought to France by the Counts of Toulouse at a later date, such as the ivory casket dated by the inscription 969-70 in the Victoria and Albert Museum, with arabesques and animals intermixed filling the ground behind the medallion made by the interlacing bands, within which two men conduct a shrine or howdah placed upon the back of a camel; carved with great precision, and so developed in style that without the inscription one would be inclined to date it much later.

At the church of S. Salvador, Val de Dios, principally an erection of the ninth century, is a beautiful pierced window slab, which I shall show you in connection with somewhat similar piercings. It also has several caps with flat arabesque scrolls filling divisions planned in the same manner as these Byzantine caps at Parenzo. S. Maria de Naranco and S. Miguel de Lino, near Oviedo, were built by Ramiro 1st (842-50). The first was originally part of a palace, and has two vaulted storeys, but has been used as a church at least since 905. The other has a dome at the crossing. The decoration includes the representation of hanging shields and plaques, evident copies of metal work in stone, and details of carving which occur in Coptic monuments. S. Cristina de Lena, another early church, has patterns which are quite Comacine in character. In the caps of all there is a Byzantine feeling, and in S. Miguel de Lino is a pierced window slab which is quite Saracenic in the geometrical patterns.

M. Enlart says that Comacine influence is evident in the south-east and south of France from Dauphiné to Catalonia, and Street cites a Spanish document of 1175 in which Raymundus Lambardus with four others (lambardos) agreed for certain works at Urgel; but the Clunists were the great builders in Spain at this period.

At Santiago de Compostella is a golden cross given by Alfonso III. (874) with precious stones and filigree and a large circle at the crossing, to which a cross of the seventeenth century has been applied. A cloisonné enamel is at the back with white doves pecking a bluish fruit on a green ground bordered with pearls and golden balls with a filigree fillet between, and the arms bear oval medallions set with stones. The ciborium of Alpais in the Louvre has an inscription round the middle which is a reproduction of the device of the Kings of Granada, while on the foot is a scroll with men and dragons running through it reminding one of Toulouse caps and of ivory carvings which resemble them in design like this one from the Victoria and Albert Museum, and the knop suggests that of the Essen candlestick.

In the archiepiscopal museum at Vich is a highly interesting series of Romanesque paintings on panel which show that at that early period there was a demand for art work in Spain, and the curious tenth century MS. of the Apocalypse at Gerona indicates that the forms of Arab ornament and architecture were being assimilated by the Romanesque designers, as is shown in the carving at Toulouse and the country round of two hundred years later.

FUTURE SUPPLY OF IRON ORES.*

An examination of the field evidence supports the conclusions of de Launay and Bäckström as to the ore being a bedded deposit overlying a lava flow, but enlarged by secondary deposition. There is only too good reason to fear that the chief iron ores are comparatively limited in depth; for most of them have been formed by water containing oxygen and carbonic acid in solution, which has percolated downward from the surface. Ores thus formed are therefore restricted to the comparatively limited depths to which water can carry down these gases. On the theory, however, that these ores are primary segregations from deep-seated igneous rocks there need be no limit to their depth. They would rather tend to increase in size downward, while maintaining, or even improving, in the richness of their metallic contents. For these bodies may be regarded as fragments of the metallic barysphere which have broken away from it and revolve round it like satellites floating in the rocky crust. On this conception these ore bodies would be of as great interest to the student of the earth's structure as their existence would be reassuring to the ironmaster, haunted as he is by constant predictions of an iron famine at no distant date. It is no doubt true that many of the richest, most accessible, most cheaply mined, and most easily smelted iron ores have been exhausted. The black-band ironstone and the clay iron ores of the coalfields, which gave the British iron industry its early supremacy, now yield but a small proportion of the ores smelted in our furnaces. The Mesozoic beds of the English Midlands and of Yorkshire still supply large quantities of ore. Nevertheless, the British iron industry is becoming increasingly dependent on foreign ores. So it would be pleasant to find that the Scandinavian iron mines are not subject to the usual limits in depth. I fear the typical iron deposits of Middle Sweden and of Gellivara will follow the general rule; but Kiruna may be an exception, and its ores may continue far downward along the surface of its sheet of porphyrite. The uncertainty in this case lies in the extent of the subsequent enrichment and enlargement of the bed; if most of the ore is due to secondary deposition, then it may be restricted to the comparatively shallow depths at which this process can act; and though that limit will be of no practical effect for a century or more to come, the ore deposit may be shallow as compared with gold mines.

The geological evidence may convince us that all the economically important ores are limited to shallower depths than lodes of gold, copper, and tin; but this conclusion shall not enrol me among the pessimists as to the future of the iron supply. Twenty years ago a paper on the gold supplies of the world was read to the Association at the request of the Section of Economics. About the time that the report was issued there were sixty-eight mining companies, with a nominal capital of £73,000,000, at work upon the Rand. Nevertheless, the author, accepting the view that "the future of South African gold mining depends upon quartz veins," concluded:—"There is as yet no evidence that the yield will be sufficient in amount to materially influence the world's production. As regards India, the prospect is still less hopeful."

That quotation may be excused, as it is not only a warning of the danger of negative predictions, but of the unfortunate consequences that happen when geologists are unduly influenced in geological questions by the opinions of those who are not geologists. In economic geology, as in theoretical geology, we should have greater confidence in the value of geological evidence. Negative predictions are especially rash in regard to iron, it being the most abundant and widely distributed of all the metals. The geologist who knows the amount of iron in most basic rocks finds it difficult to realise the possibility of an iron famine; he can hardly picture to himself some future ironmaster complaining of "iron, iron everywhere, and not a ton to smelt." There are reserves of low grade and refractory materials which the fastidious ironmaster cannot now use, since competition restricts him to ores of exceptional richness and purity. When the latter fail, an unlimited quantity could be made available by concentration processes. The vast quantities of iron ores suitable for present methods of smelting in Australia, Africa, and India show that the practical question is that of supplies to existing iron-working localities, and not of the universal failure of iron ores.

* Extract from the address of Prof. J. W. Gregory, D Sc., F.R.S., President of the Geological Section of the British Association, at Leicester.

RUSSIAN COTTAGE INDUSTRIES.

The conditions governing the politico-economic life of Russia during the last two or three years have influenced manufacturing industries unfavourably; the output of several branches has been materially reduced, and that of others has ceased entirely. The same fate has overtaken the cottage industry, a type that plays a prominent *rôle* in the economic life of many districts of the Empire. This is confirmed by the reports of those zemstvos in whose governments this form of industry predominates. Thus, in the government of Moscow, the unemployed tailors of the districts of Vereisk and Bogorodsk have taken to lumbering, and the gold leaf beaters of Dmitrovsk to picking stones off village fields. According to the American Consul at Riga, the following crafts have suffered most from the hard times:—The manufacturers of brushes, the workers in brass fittings for harness, joiners, carriage makers, the weaving industry, tailors gold beating, &c. As a type of one of the industrial villages, that of Pavlovo may be taken, of which the following is a description:—This village is situated on the left bank of the river Oka, in the government of Nijni Novgorod, and has a population of 12,000. The chief employment of the village is the production of articles of metal, th

manufacture of locks alone giving employment to 1,400 cottages, with 1,500 male artificers. The form most produced is that of padlocks. Latterly the manufacture of box and door locks has been taken in hand, since the opening of an industrial school with modern workshops. Besides locks the following steel wares are manufactured—knives, forks, scissors of all kinds, razors, surgical instruments, beams for scales, corkscrews, shovels, &c., and small castings of tin and lead. In the manufacture of padlocks the prevailing type of industry is that of the family, for with the exception of the bows and springs, all the parts are made by the artificer and the members of his family of ten years old and upwards, the employment of outside help being the exception. According to size and kind of lock, a family is able to manufacture weekly ten to one hundred and fifty locks. Excluding the products of the larger factories which find their way direct to Moscow and the larger cities, the entire trade of the district is in the hands of local middlemen. Many steps have been taken with a view of ameliorating the lot of the cottager and of giving him a larger share in the product of his industy, and individual zemstvos, as that of Nijni Novgorod, by the opening of industrial schools and workshops, founding "artels" (workmen's societies), establishing depots for the sale at cost price of the raw material required by the craftsman, and also with money grants for the maintenance of these institutions, and to provide medical aid to the district, have done much to support and encourage the cottage industries in their own governments. In view, however, of the large population engaged in this type of industry, unity of action and larger grants than the individual zemstvos are capable of supplying are indispensable, and the central Government is being called upon to assist in the work.

TRADE BETWEEN PERSIA AND INDIA —THE NUSHKI-SEISTAN ROUTE.

A few years ago, during Lord Curzon's Viceroyalty of India, the Nushki-Seistan trade route was organised for the purpose of providing an outlet by land for the trade of Western India, and a direct means of interchanging the products of Persia and India. Mr. Edward Penton read a paper on this route before the Indian Section on December 5, 1901, (see *Journal*, vol. l., p. 65). Major Webb-Ware, the Political Agent at Chagai, who did so much for the opening up of the route, has just written a report on the statistics of the trade passing over the route during the year 1906-07, from which it appears that there was a considerable falling off in the figures as compared with those for 1905-06. The exports in the year 1906-07 were Rs. 6,15,266, and imports Rs. 6,28,634, or altogether Rs. 12,43,900, being a falling off of no less than Rs. 3,01,081, this being manifested almost wholly in the exports, for the imports showed a slight increase. The export trade passing through Nushki, which, it may be observed, is in the nature of a frontier mart, goes to Afghanistan, Persia, and Baluchistan, and though, as already mentioned, the exports to all these countries have decreased, the falling off is far larger in the case of Persia than in the other two. Major Webb-Ware ascribes this partly to the outbreak of plague in Seistan, and consequent preventive measures, but some other causes may have contributed to the unfavourble result. The chief decrease, so far as Persia was concerned, was in indigo (Rs. 89,820), hides and skins (Rs. 19,127), and tea (Rs. 7,255). In the exports to Baluchistan the decreases were observable in cotton piece goods, grain and pulse, and provisions, in the order named. In the imports from Afghanistan and Baluchistan there were slight increases, but the Persian trade was so bad that the imports fell off as well as, though not to the same extent as, the exports. The decrease was greatest in the case of turquoises and precious stones, and one explanation of this is that advantage was taken of the parcel post to transmit these stones under cover, and that they thus escaped registration.

As regards the question of carriage, which depends on the supply of camels, some difficulty is experienced on the fact that the western part of the Nushki-Seistan trade route traverses practically uninhabited country, where in summer grazing is scanty and the heat excessive. But by dividing the route into two sections, and establishing the head-quarters of the western half at Robat, under a separate camel contractor, working under the British Consul, improvement in the trade is anticipated.

The horse trade shows no signs of animation. Persian horses are not regarded favourably in these days by our native cavalry regiments, and prices in Khorasan are out of proportion to the quality of the animals. Formerly in the days of Turcoman raids it was essential for every Persian village to have a body of well-mounted men, but this necessity has of course long ceased to exist.

To sum up, the trade returns for the year appear at first sight discouraging, but when it is borne in mind that riots broke out in Seistan in consequence of the plague preventative measures, the exceptional features of the year will be better understood. Quarantine stations and plague cordons were established on the main routes connecting Seistan with Meshed as well as Seistan with Quetta, and many carriers took fright and declined to fulfil their engagements and proceed beyond the frontier. No case of plague had at the date of the report appeared in South-Eastern Persia for upwards of eight months, the cordons are being withdrawn, and there are several signs that trade is likely to revive. It would be interesting if in his next report Major Webb-Ware were to furnish information regarding the operation of the Persian Custom duties, which are alleged to be unfairly enhanced against British Indian trade, and which may be responsible for much of the decrease noted in the present statistics.

HOME INDUSTRIES.

Coal and Ships.—The exports of coal during the half-year ended June 30th last show considerable expansion. They amounted to 30,802,213 tons, as compared with 27,587,700 tons in the corresponding months of 1906. These figures include coke and patent fuel. The exports of coal alone total 29,675,774 tons, as against 26,548,462 tons in 1906, an increase of no less than 3,127,312 in six months. The increase is largely due to the German demand, it being to Germany direct 703,150 tons, the shipments to Holland showing an increase of 837,174. The abnormal condition in Germany, whose industrial consumption and interrupted production have compelled her to import larger quantities from the United Kingdom, has helped the industry here, and quickened shipments to France and elsewhere. The bad weather, too, has prolonged the busy season. A large number of contracts have still to be covered. A good deal of small coal is contracted for to be shipped to German ports; France is contracting largely for gas coal, and the pressure of orders for Welsh steam coal has been renewed. All this points to continued activity in the coal trade, but signs are not wanting that this abnormal prosperity is nearing the end. American coal is now cheaper f.o.b. port of shipment than Welsh coal, and is being pushed even in the Mediterranean. The Italian navy has been buying American coal, and the Italian State railways are said to be negotiating for a supply from the United States. The cost of production is beginning to tell. High prices here f.o.b. for steam coal, and high outward freights, means dearer "bunker" coal and there is no likelihood of the cost of production lessening. It may be some little time before we have a statutory eight hours' bank-to-bank day for mining, but the pressure upon the Government to carry it is great, and the evidence taken before Mr. Russel Rae's Committee proves it would materially raise the cost of production. But it is not only shortened hours of work that is likely, the Miners Federation of Great Britain are about to convene a national conference for the purpose of organising a comprehensive scheme intended to raise the basis upon which the minimum wage shall hereafter be calculated, a charge which, if brought about, must of itself seriously effect working costs. The outlook cannot be viewed with unconcern by the shipping industry. It was demonstrated to the Departmental Committee that the proportion which coal bears to the working of steamers ranges from 25 to 30 per cent. in the case of tramps, to 40 to 45 per cent. in the case of mail steamers, and to close upon 50 per cent. in the case of the very large and fast steamers. It has been estimated that every shilling per ton added to the price of coal means £1,000,000 per annum added to the cost of operating British shipping, and if this estimate is near the mark the working costs of British steam shipping is now from £3,000,000 to £4,000,000 per annum more than they were in 1905, without any compensation in the way of higher rates of freights; on the contrary freights are low and likely to remain so, and working costs are not likely to be lessened but rather increased by the new Merchant Shipping Act and the Workmen's Compensation Act.

Railways and Waggons.—The railway regulations in regard to private owners' waggons have now been revised by the Clearing House, and the new rules came into operation on August 1st. They stipulate that siding rent will be chargeable to the owner, or his agent, in respect of standing room for any waggon detained at a station or siding for repairs at a rate of 6d. per waggon per day, exclusive of Sundays, and for shunting such waggons into and out of the premises of private waggon repairers a mininum charge of 6d. per waggon will be made. Other clauses are designed to protect the companies against claims for delay due to causes other than negligence on their part, and the notice containing these alterations also states that they will not be liable for any injury that may occur to waggon repairers, who will be required to execute an indemnity before they are allowed to work on the companies' premises. The Association of Private Owners of Waggons is at present engaged in litigation with the railway companies as to the whole question of siding rents, and the Courts are to be asked to define the respective rights of owners and companies in the matter of private railway waggons.

Cotton Bills of Lading.—During the present year much disatisfaction has been expressed with the way in which through bills of lading for raw cotton are issued in the United States. It would seem that a custom has grown up under which bills of lading can be obtained for cotton as having been received at the port of shipment for export by a specific steamer, when in fact the cotton is up country, and owing to the congestion on the railways, likely to remain there for some time, cases having occurred where it has not been delivered at the port of destination in Europe until three or four months from the date of the bill of lading. The result is much trouble and loss to importers, and the principal cotton associations and other organisations of merchants and buyers have been trying to find a remedy. A conference has been held at Liverpol on the subject, and it is hoped that good may come from it. Referring to this important matter, the Liverpool Cotton Association has published the following comments:—"1. The objection to the so-called 'ocean bill of lading' is that in the majority of cases it erroneously purports to show actual delivery at a port of goods which are still in transit, and that the holder of such bill of lading has no proper security, because (*a*) he is entirely dependent upon the honesty of the ship agent in the port of shipment, to whom the goods are consigned, and who has entire control of them on their arrival at the port; (*b*) even if the signatory of such bill of

lading is an 'authorised agent' of a steamship line the latter assert that they could legally disclaim responsibility if it could be proved that their agent had acted *ultra vires.* (2) The remedy proposed in Galveston consists in a so-called 'exchange bill of lading,' *i.e.*, a receipt given by the ship agent for the 'railway bills of lading,' and a promise on his behalf to forward by certain steamer or steamers the goods enumerated therein. Some suggestion is made that such bills of lading should be certified by a railroad clearing-house. Objections are raised to the 'through bill of lading' (apparently on behalf of Texas bankers) on the ground that it does not give a sufficient guarantee, because under this bill of lading the responsibility of each carrier ceases as soon as the goods have been turned over to the next carrier, and it is, therefore, stated to be extremely difficult to trace the goods, and 'practically impossible to prove the liability in any Court.' (3) The European importing interest contends (*a*) with regard to the 'exchange bill of lading' that the only advantage of this bill of lading lies in the fact that it frankly states that it is not a port bill of lading, but only a receipt for certain 'railway bills of lading,' but that otherwise the objections to the ocean bill of lading also hold good in this case; (*b*) with regard to the through bill of lading, experience in the past has shown that there has been no difficulty in attaching full responsibility to any individual railway company which has not fulfilled their part of the contract; (*c*) that the importers therefore consider that a through bill of lading which stipulates that the goods are to be consigned to the care of the ship at port of shipment, or to an agent for whose acts the shipowner will accept full responsibility, gives a sufficient guarantee of continuity of responsibility from the time of shipment in the interior until delivered at the European port, and is therefore preferable, as a collateral to be attached to an interior bill of exchange, to both the suggested new exchange bill of lading and to the present ocean bill of lading."

The Railway Companies.—It is not surprising if investors in railway stocks are seriously perturbed at the continuous decline in values. They have been accustomed to regard stocks of the more prosperous railway companies as among the best of securities, and they consider it strange that, at a time when the trade of the country is said to be exceptionally active, the capital value of their railway investments is lower than for many years past. Take for example the consolidated stock of the London and North-Western Railway Company, not only the most important company in the kingdom, but one of the best managed. In 1906 the average price of this stock was 155¼; last week it was quoted at only a fraction over 140. Last year's quotation represented a most serious fall as compared with say that of 1900 when it was 186¾, and the dividend distribution was lower, but the fall has continued, and it would be a rash prophet who said that it will not go further. The decline in market values is not invariably in accordance with common sense, but it may be assumed that among many causes prejudicially affecting railway stocks at the present time the price of coal and the agitation among the men for higher wages take foremost place. It is understood that the railway companies will have to pay something like 3s. per ton advance on the last contract prices. That is a serious addition to working costs. According to the Board of Trade returns for 1905 the consumption of coal for locomotive purposes on the railways of the United Kingdom for the year amounted to 11,593,758 tons, and this quantity at 3s. per ton represents £1,739,064. The effect in increased cost of 3s. per ton advance in price of coal used by the London and North-Western Railway Company means £203,022. Then it is considered probable that the railway companies will concede at least a part of the men's demands in the matter of wages, which means another considerable addition to working expenses. Add to this the growing requirements of the public where speed, service, and comfort are concerned, and some of the causes making for the depression of railway stock values are disclosed. But when due allowance is made for these and other factors the present level of quotations would seem to be unduly low.

GENERAL NOTES.

DRAWING AND ART TEACHING CONGRESS, 1908.—The third International Congress for the Development of Drawing and Art Teaching will be held in London during the first week of August, 1908. Two previous Congresses have been held, the first in Paris in 1900; the second in Berne in 1904. The Congress, it is expected, will bring together representatives of drawing and art teaching from all parts of the globe, and in connection therewith a large and comprehensive exhibition is proposed, which will show the methods of art teaching pursued in the various countries of the world. Applications for space and enquiries have already been received from Germany, France, Russia, Italy, Austria, United States, Egypt, India, New Zealand, Newfoundland, and many other places. Among the list of Vice-Presidents are the ambassadors for France, United States of America, Germany, Italy and Austria-Hungary, and other distinguished authorities. The chairman of the British Committee is Sir John Gorst, and the vice-chairman, the Earl of Carlisle. The organising secretary is Mr. C. M. Mathews, whose address is at the office of the Congress, 151, Cannon-street, London, E.C.

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FRIDAY, AUGUST 16, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The results of the Intermediate Examinations (Stage II.) were published last week, and copies for distribution to Candidates have been sent to all Centres. The results of the Elementary Examination (Stage I.) will be published at the end of this month, or early in September.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ROMANESQUE ORNAMENT.

By F. Hamilton Jackson, R.B.A.
Vice-President of the Society of Decorative Designers.

Lecture II.—Delivered March 4, 1907.

It is impossible, in the short time at our disposal, to go over the other countries of Europe in even as full a manner as France has been treated, but we may have a few interesting examples from Italy. The church of St. Michele, Pavia, shows by the differences of its walling that portions of it belong to three periods, re-buildings, no doubt, after fires and sackings of the town. The bands of carved ornament show the use of older material also, the irregularities in the widths of portions which should match, as well as the difference in the style of the fragments, making it impossible that they can occupy their original position. There is a mixture of motifs with a Byzantine origin, of figures of varying degrees of incompleteness, some of them bearing a resemblance to the barbarous Irish figures, of monsters and of hunting scenes, and in the side doors patterns of a much earlier type, mixed with Roman and Byzantine details, such as the rings containing half-figures supported by angels, and the vase flanked by doves. At S. Maria, Maggiore, Barletta, the horizontal lines of fighting figures are twisted round the archivolt, which they fill, the proportions being stumpy and the relation of human to animal or bird figures unnatural. This church has an extraordinary mixture of Lombard work with Oriental-looking pierced marble grilles, and an eastern end which is French Gothic in

style. At San Leonardo, between Siponto and Foggia, is a very beautiful door with fine arabesque scrolls, among which birds, beasts, and monsters are intertwined, in almost perfect preservation. The convent belonged to a German military order, but I cannot see any specially German character in the design, the sharp thistly foliage being rather Byzantine. The figures show the usual inadequacy—note Balaam and the Angel and the Adoration of the Magi on the caps—subjects which recur at Monte Sant' Angelo in the same positions. The beautiful ease in the flow of the curves shows that this is rather a late example. Compare it with this very fine door at Bitonto which M. Bertaux gives to Frederick the Second's time, partly on the strength of the eagle above. The eagle appears to me to be a later addition, and the arrangement of the pillars with griffins above and lions below is exceedingly like that at Ruvo, so I should be inclined to put it a little earlier. This window from S. Abbondio, Como, I think is difficult to surpass as a piece of ornament. The spaces are well-filled and balance quite satisfactorily without being at all alike, and the contrast of the flatly-treated carving with the twisted moulding and colonnettes is very happy. The only drawback is that the little eagle caps are scarcely important enough. The whole of the Cathedral of Modena is worthy of attentive study, and I show you now one of the south doors, the Porta Principe, with the story of S. Gemignano on the lintel, and a very fine and inventive pattern of lines which flow and return and interlace, with figures among the arabesques upon the jambs and archivolt, the work of Nicholaus probably, to whom so many of the fine portals are due, as at Piacenza, Ferrara, and Verona. At Montefiascone, near Viterbo, is a very interesting church of the eleventh century with two storeys communicating by a well as in the chapel of the castle of Landsberg, and here the carving shows Lombard influence very strongly, both in the creatures themselves and their actions, while the plan with a pillar and a pier alternately is also Lombard. Yet certain of the ornamental forms are based on Byzantine data, and may be parallelled by others found in the south of France. And in this capital from the cathedral, Veglia, the place of the usual leaves is taken by gambolling beasts of pronounced Oriental type and birds facing each other within semicircular-headed forms, with the usual grooved volutes, while a band of scroll work runs round the neck. This arrangement of ornament within semicircular-headed forms is found on the Sassanian vase already referred to. Other caps in this cathedral are fine examples of pure Byzantine work, and there is one which is an exact replica of one at Spalato which formed part of the campanile. The east window of the cathedral, Bari, is one of the finest examples of carved ornament of the end of the twelfth century known to me. The elephant supporters below the shafts and the man and woman sphynges above are carved admirably, and the animal forms combine well with the arabesques in the panel below. This kind of window in the screen wall between the towers which flank the apse is peculiar to the Apulian churches, and another example, equally beautiful, looks over the harbour at Trani from the church of Ognissanti. This door of the cathedral, Foligno, so closely resembles work at Bevagna signed by two Ghibellines, Rodolphus and Binellus, as to make it pretty certain it also is theirs. The projection of the symbols of the Evangelists from the inner border of the arch is very curious. The pattern on the left inner jamb occurs on a church at Toscanella and the archivolt is divided up into rectangular panels as at S. Michele Pavia—classical influence is evident in some of the details. The little arcade for the ceremonial of Palm Sunday occurs on a larger scale in the thirteenth century addition to S. Pietro, Toscanella—where is a very fine wheel-window flanked by two of two lights with a broad band of carving round them which recalls the work at S. Pietro, Spoleto, and S. Maria Impensole at Narni. The interior of this church is interesting both on account of the ritual arrangements and for the carved ornament. Some of the caps resemble in line and spacing other examples in France, and there is a good deal of flat ornament of the eleventh century about the choir, which was recast at that time, when a crypt was made. A little vestibule to the crypt with an altar in it has one most curious cap with the lines of the volutes continued across the front and crossing, as in certain caps found both in Etruscan tombs and in Crete.

In the Abruzzi the sculptors appear to have preferred high relief to flat carving, as this ambo at S. Clemente in Casauria shows, a quite typical example. The Byzantine influence is strong in the mode in which the stone is cut with the effect of piercing, and in the arrangement and choice of some of the details, though the planning of the ornament is original.

But the Oriental influence in several places is still stronger, and at Cugnoli and Moscufo one finds definitely Arab motifs mingled with the ornamental details. In Apulia the sculptors of church furniture preferred to work in marble, with a flat treatment and a good deal of inlay, as in the fine ambo at Bitonto made by Magister Nicholaus, in which inlays of coloured marbles and vitreous pastes are used. There is another in the church which has gilded patterns on dark blue glass in the interstices of interlacings; and at Canosa is one which resembles examples on the Western Coast, while quite a number of episcopal seats exist with flat Byzantine-looking ornament carved in white marble. The patterns on the narthex of S. Maria, Pomposa, are of terra cotta, and the dislocations show that rebuilding has taken place. Exactly similar patterns decorate the great Campanile, which has an inscription upon it dated 1063; but probably the marble has been encrusted in the wall as the fragments have been in the wall of the narthex, for a date of 1115 is given by an inscription upon the latter, which agrees better with the style than 1063.

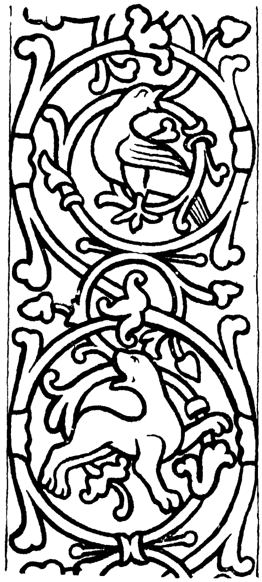
To return for a short time to France, to the cloister at Moissac, the capitals in which are among the finest productions of French chisels of the period. The buildings carved upon them have round arches, though the structural arches are pointed, a discrepancy which suggests a rebuilding at some time. The columns are of four different kinds of marble, but the caps are of limestone, grey or yellowish, and probably date from the second half of the twelfth century, before Richard Cœur de Lion took the town in 1189, though the cloister may have been rebuilt about 1271, at which period the pointed arches were probably added. Some of the caps show animal and bird forms, arranged very ingeniously to produce ornamental grouping of lines, and the contrast between the bell of the capital and the abacus is always marked by a difference in the scale of the creatures or of their kind, or by the purely ornamental arrangement of them, and in many cases simple ornamental forms are used, the abaci being in general treated most simply where the interest of the ornament upon the cap is greatest. The single columns seem scarcely thick enough to satisfy the eye as compared with the wide-spreading of the caps — a legacy from the practice of the Lombards, though the large sloping surface is covered with cleverly-designed ornament; and the greater solidity of the angles, where coupled columns flank the pier, is more satisfactory. Most of the heads in the figure-work have been knocked off; the one now before you, which represents Daniel among the lions, and is rather better preserved than most, wlll show that as usual the accomplishment of the ornamental carver is greater than than that of the figure sculptor. A cap in the museum at Toulouse has this subject with an absolutely similar figure of Daniel, and the side of the porch, which has the subject of the Rich Man and Lazarus, shows the rich man with the same Jewish kind of cap. M. Marignan relies upon this detail to prove that the two are contemporary, but the capital at Toulouse is thought to be earlier than those at Moissac. The inscription in the cloister gives the name of Abbot Ansquetil as builder (1085-1115), but the caps have been ascribed to Abbot Roger (1115-31) whose figure, inscribed with his name, occupies one of the engaged pillars of the external wall of the porch. M. Marignan says the costume is of the last quarter of the twelfth, but the details of furniture, &c., belong to the beginning of the thirteenth century. The ornament, which is cut with great dexterity, may be influenced by Arab work from Spain, by Greco-Oriental objects or Oriental stuffs, while some of the figures show traces of the Gallo-Roman tradition. The Albigensian wars practically put an end to the early Tolosan school. At Moissac there was a destructive fire in 1188. Next year Richard Cœur de Lion took the town, which remained English for eight years. Fifteen years later Simon de Montfort took it and Raymond VI. afterwards punished those who had deserted his cause. In 1229 the town walls were razed, so that it seems certain that the carving must have been done before 1188.

Byzantine art is a complex product based upon Persian, Syrian, and Egyptian design as well as upon the debasement of classic forms. The details of ornament came from Assyria, Phœnicia, and Judæa by way of Asia Minor before the Arab invasions. Such details as the sharply cut and spiky foliage, the galleries over the aisles in the basilicas, the three apses polygonal externally, and a few new iconographic subjects came from Syria. The development of the style was complete in the seventh century, though it is probable that the iconoclastic struggle had something to do with the general preference for ornament in place of figure sculpture which spread over the West also, for protestations against the luxury of the churches and the cult of icons proceeded

from Syria and Phrygia quite early. In the West, Bernard of Angers at the beginning of the eleventh century expressed indignation on seeing statues of gold and silver at Conques, declaring that this pagan custom would be considered sacrilege in countries farther north. The Germanic races appear to have refrained from representing their deities, even in Pagan times, while the French probably owe to the admixture of Latin blood their delight in the use of figure sculpture wherever it is possible to introduce it, and the excellence which has characterised their work of this kind at almost every period.

Constantinople and the cities on the Bosphorus were the rendezvous of caravans from Pontus on the north-east, Armenia on the east, and India and Persia by way of the Tigris and Euphrates, and Jornandes says that Persian products were sold in the Gothic towns on the Black Sea, which were ancient Greek colonies. In the stores, by the side of Hindu, Persian, and Egyptian importations, were the products of the imperial city which had then an enormous vogue. The specialities were woven or embroidered stuffs, jewellery and goldsmiths' work, carvings, enamels, and ivories. The ivory carvers' shops had diptychs, triptychs (a Byzantine invention like a holy door) caskets, and isolated panels which were often applied to book covers. Halitgaire, Bishop of Cambrai, ambassador in 828 from Louis le Debonnaire to Michael le Bègue, brought back such panels with him. In antiquity silk stuffs enriched with ornaments or embroidered came from Egyptian or Asiatic workshops to Eastern Europe, like the royal robes pictured on the Assyrian reliefs and the figured stuffs represented on ancient painted vases. Asterius, Bishop of Pontus, at the end of the fourth century, says in a homily, "They buy eagerly, both for themselves, their wives and children, clothes covered with flowers and offering images of an infinite variety. There one may see lions, panthers, bears, bulls, dogs, forests, rocks, hunts—in a word all that the work of the painter can produce to imitate nature. The most pious of these rich men take subjects from the Gospels." The use of such sumptuous robes continued and spread, and in the eleventh century French and Normans admired the embroidered clothes of the British nobles, and recognised that the English excelled all others in this kind of work. It was soon called *Opus Anglicanum*, and till the thirteenth century the English retained their supremacy in the craft, though the French also thought the Germans good at it. Germans who excelled came to England to learn their trade. Otho III. had a cloak with scenes from the Apocalypse, which was probably worked by the Abbess of Quedlinburg, and the cope which Henry III. gave to the cathedral of Bamberg remains as an example of the excellence of German workmanship, while the Syon Cope and that stolen from Ascoli and restored by the munificence of Mr. Pierpont Morgan bear witness to the English mastery.

FIG. 9.



ORPHREY FROM CHASUBLE OF S. WOLFGANG, RATISBON.

M. de Farcy claims this cope as French work, The chasuble of S. Wolfgang, preserved at Ratisbon, shows ornament of English character (Fig. 9). He was brought up at Reichenau, rose to eminence, becoming Bishop of Ratisbon after going to preach to the Hungarians in 972. He died in 994, and MM. Cahier and Martin say that the braids upon the vestment are of the tenth century.

The splendid dalmatic, said to have been Charlemagne's, but 200 years later than his time, in the treasury of St. Peter's, at Rome, has embroideries of the Transfiguration, Christ in Glory, and the Last Supper. Christ stands by an altar, and gives to six apostles bread on one shoulder, and to six others wine from a two-handled chalice on the other. It is probably Greek work to judge from the costumes. An eleventh or twelfth century cope preserved

at Metz, with eagles embroidered on red silk, is Oriental. On the wings are roundels containing griffins, an eagle stooping on a hare, crescents and liney scrolls in gold, white, green, and yellow. It resembles Frederick II.'s mantle at Vienna. Mgr. Wilmowsky found in tombs of archbishops of the twelfth century at Trèves, vestments with patterns of this kind based upon Oriental motifs. Diamonds filled with figures of standing lions, circles containing griffins dancing back to back, and peacocks face to face standing in the spaces between the circles, a space which in other parts of the design is filled by a pattern of palmettes of a quite Greek shape. The ring of Ethelwulf, father of Alfred, preserved in the British Museum, shows upon a mitre-shaped surface, in niello, a kind of tree bearing two circles containing quatrefoils, probably symbolising the host, flanked by two peacocks bearing a close resemblance to Oriental textile figures.

FIG. 10.

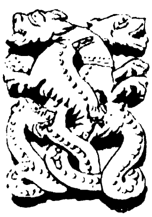


FIG. 11.

At Toulouse are carvings apparently copied from Byzantine embroideries with pearled scrolls which interlace, and on the façade of S. Gilles are roundels which resemble textiles of Cappadocian origin. From Naples southwards to Salerno, ninth century plaques still exist with winged horses, griffins, and peacocks within circles, or like this one from Atrani, all of which are quite evidently Oriental in their derivation. The well-known subjects on the screen at Torcello, which are early eleventh century, also show the same feeling with greater mastery, and bear considerable resemblance to the panels encrusted on the cathedral at Athens, which M. Bertaux claims as being based on Sassanian motifs. At S. Pietro in Civate are incised slabs with monsters of quite Oriental type upon them, and at Ancona and Venice are other slabs, both incised and in relief, which show Oriental influence quite as strongly, while one of the mosaics at Germigny-des-Prés was asserted by M. Courajod to be a copy of a Persian miniature. At S. Sernin, Toulouse, a cap below the statue of S. James shows that the sculptor copied an ivory which was probably Hindu from the types of feature and costume, and in the nave of the cathedral, Bayeux, a series of panels is placed upon varied diapered grounds in the spandrils of the arcade which also appear to have been copied from Hindu or Chinese ivories or bronzes, the

FIG. 12.

FIG. 13.

monsters retaining a great deal of the original feeling (Figs. 10 to 15); and on one of the arches pendant pine cones occur as an ornament, which are also found upon capitals in the South, as on this one from the triforium of S. Sernin, Toulouse, upon another in the eleventh century church of S. Adriano, in Calabria, and elsewhere. Now in the British

FIG. 14.

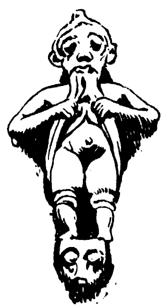


FIG. 15.

CARVINGS FROM BAYEUX CATHEDRAL.

Museum there is a Syrian cap from the Harâm-es-Shereef, Jerusalem, which has this identical feature coupled with the usual thistly foliage of the sixth century, another instance of details of which the origin is demonstrably Oriental. It is much the same in Spain. The chain of the votive crown of Reccesvinthus, now in the Musée Cluny, is composed of links of a quite Hindu shape, as is one of the chains of those in the Armeria

Reale at Madrid. In the museum in that city is a crucifix brought from Leon, made for Ferdinand of Navarre, who died in 1065, and his wife Sancha, sister of Bermudo III. of Leon, who died two years later. The patterns of the ornament show Oriental influence strongly both on the front and the back, which I am able to show you, and the difference between the struggling figures of the front border and the developed ornamental forms of the back, some of which appear to be quite twelfth century, is striking. There is the usual inferiority in the treatment of the principal figure, but the Evangelistic symbols on the arms are satisfactory from the point of view of design, filling the spaces well. In the treasury of the Abbey of Silos is an extraordinary chalice of rather earlier date, ornamented with arcading of horse-shoe arches in filagree and precious stones which is supposed to be the work of a Moorish slave of the abbey, as the only way of explaining the curious use of Arab forms. The fine twelfth century Limoges retable, once belonging to the same abbey, shows round-arched canopies and Byzantine-looking figures, with a running ornament which is exactly like a Coptic ornament on the abacus of a cap at El-Azhar, Cairo. The same pattern also appears several hundred years later in the mosque of Sultan Hassan. The relations of Limoges with the East are known. Between the Caliph of Cordova and the Emperors of Constantinople there were were also continuous relations, and Greek artists and savants often went to Spain. From other parts of Europe pilgrimages to Jerusalem were frequent, which went by way of Constantinople, while embassies were sent from one side or the other between Germany, Italy, and France, and Byzantium.

The sacred crown of S. Stephen, kept in the castle of Buda-Pesth under seven locks, the keys of which are kept by seven different magnates, is an instance of the costly gifts from Byzantium. It was given by Michael VII. (1071-8), and his son, Constantine Porphyrogenitus, to Geysa I. of Hungary, in consequence of a defeat of the Greeks and Bulgarians, in which Geysa showed so much bravery that Michael sent an embassy to conclude a treaty. Geysa then became king, and the crown was, no doubt, sent as a present. Three of the enamelled plaques bear figures of the monarch. It is impossible to see this crown, but there are in the museum fragments of another, made for Constantine Monomachos, which had similar plaques of cloisonné enamel.

The two countries which were most directly affected by Byzantine influences were Germany after the marriage of Otho II., and Italy in general during the later exarchate, and specially in the south-eastern part, which was governed from Constantinople, except for certain intervals, till the Normans established themselves in Apulia, in the eleventh century, where Greek was the language of the people, and the church looked towards Constantinople and not towards Rome. Here the paintings of the Basilian monasteries and grotto churches show that an original civilisation on Oriental lines was developed quite early; the influence was not the effect of a domination imposed on subject peoples, but the natural expression of a kindred race. In Rome itself the Byzantine influence continued till the end of the tenth century, largely through the Greek popes, who employed Oriental artists to decorate the churches, and the crowds of orthodox monks who fled before the Arab invasions of the seventh and eighth centuries. At Ravenna, a quarter in the city was inhabited by Armenians, in the ninth century a virile and powerful race, and Greek soldiers formed part of the garrison. Syrians were so numerous that they were able to nominate one of their number for the episcopal dignity during the time that the Exarchs ruled. The Byzantine influence was mixed with Lombard, for the powerful duchy of Benevento ruled a great part of South Italy for more than a century; and at Brindisi, at Benevento, and Ascoli are remains of buildings of that period. The church of S. Benedetto, Brindisi, is one of these buildings, a good deal altered in later days, but still retaining portions of the old work. It is the south door of this church at which you have been looking, built of ancient fragments at a later date, and this is the cloister, which is very primitive in its construction, though the small arches are grouped beneath discharging arches which take the weight of the wall to the piers. The curious capital with the beasts back to back is an earlier form of one of the fine capitals in the external gallery of the matroneum of the Cathedral of Bitonto, a work of much later date, ascribed to the period of Frederick II., but probably a little earlier. Here there is a decidedly Indian flavour in some of the ornaments, such as the leaf-shaped projections forming pseudo-cap to the second column, and the band round the nearest one, mixed with reminiscenses of classical and Syrian ornament. At Benevento there is a cloister which is a good deal like S. Benedetto,

Brindisi, belonging to the church of S. Sofia, also a Lombard foundation. It was re-built in the eleventh century, but a good deal of the old material was used, and you may see by the shape of the super-abaci, which are of the true Lombard type, and by the character of the carving that the old traditions were not abandoned. At the castle of Quedlinburg, in the atrium to the chapel, there are colonnettes and caps resembling these in character, and showing that Lombard influence had some hand in forming the German Romanesque. Another Lombard feature which one sees continually in the earlier German churches is the external gallery, probably a development of the open loggia. The laws of Liutprand mention dwarf colonnettes of four or five feet high, which could only have been used for cloisters or for such galleries, whether with arches or without, as in the apses of S. Frediano, Lucca, and in Pisa Cathedral, and in the cloister of Voltorre, the village from which the artist family came which furnished architects for 200 years to the cathedral, Modena. This view of the interior of that building shows the entrance to the chapel beneath the choir, constructed with portions of the ancient ambo of which other portions may be recognised in other parts of the church. Such lions, or griffins, are met with at the doors of churches all over Italy during the twelfth and thirteenth centuries, and have had all kinds of symbolic meanings attached to them. Outside this cathedral they occur, both at the south, west, and north doors. A reconstruction is shown by the difference of size of the lintel and the archivolt of the north door. On the lintel are subjects from the bestiaries, including the charity of the fowls to the fox in affording him Christian burial, who requites them on the right in the usual manner of the world. Round the archivolt is a subject of knights besieging a castle, one of whom is titled "Artus rex Britaniæ." The Arthurian epic, like that of Roland, often furnished subjects for the decorator. At Bari it appears on the archivolt of one of the side doors of S. Nicola, which has evidently been altered or restored as the dislocation of the design at the springing of the arch shows, where the two subjects from the labours of the months have been put in. The beautiful arabesques are the work of a Greek, named Basilius, or at least a man of Greek extraction, while, close by, the west door is signed by two Comacines, Ansaldus and Taddeus, showing that the same amalgamation of the different styles was proceeding here where Byzantine influence was so strong; and it is curious to note that in the door to the left in the same façade the Comacines use the classic egg and tongue; and you may also see the Byzantine ball flowers and the spiral grooved form (an Eastern detail), while upon the jamb there are figures of warriors fighting among the arabesques, no doubt copied from some ivory casket as in Barisano's work. The west door of the church of Ruvo is I think the finest example of the result of the amalgamation of the styles in Apulia. Parts of the church are of the period of Frederick II., but there was an earlier building, and it seems probable that the doors belonged to it, both from the style and from the fact that they seem out of scale with the rest of the façade. Here the arabesques run without a fault and the surface is enriched without being overloaded, and though the figures are rather poor, as usual, they are not very conspicuous. A door of something the same character enriches the west front of S. Maria in Piazza, Ancona, and is dated 1210 and signed by the sculptor Philippus. It shows the same, or even greater, inability to carve the figure coupled with complete mastery over both the design and execution of the ornament.

On the other side of Italy also Byzantine influence was fruitful in the development of ornament. While the frescoes in the chapel of S. Laurence at S. Vincenzo, Volturno, are based on the same models as the miniatures in the Carolingian MSS. and resemble them in design. In the MSS. at Monte Cassino there is the same mixture of interlacings, monsters, and foliage scrolls as in the Winchester work, but less tastefully arranged and quite 100 years later in date. The great developement occurred after Desiderius brought over the Byzantine enamels, which suggested improvements in colour as well as in the composition of the subjects. The flowers and scrolls of the big initials in the Vatican Bible, M. Bertaux says, are exactly like the engravings filled with a black mastic which decorate the bands of marble on the walls of the church at Daphni, and one MS. signed by a monk named Leo (1072) and with a drawing of him on his knees before S. Benedict and many miniatures, is so Byzantine in style and shows such an advance in drawing and conception, that it is probable that the miniatures were copied from a frontal show ing the miracles of S. Benedict in cloisonné

enamel made at Constantinople by order of Desiderius. He engaged Lombards and Amalfitans to build and then required men from Constantinople to decorate, "who brought the arts forgotten in the west; mosaic of enamel and of marble, using both figure work and geometrical decoration." Much of the magnificent goldsmith's work for the sanctuary was made in Constantinople, but a good deal was executed in the monastery in imitation of the Byzantine treasures, for he ordered that the monks and the young novices should be taught the most various kinds of art: "to work in silver and gold, in iron, glass and ivory, stone, wood and plaster." Here we see the same kind of universal activity as reigned at Hildesheim under the instruction of S. Bernward.

The earliest of the bronze doors which still exist in the south of Italy were importations from Constantinople, commencing with those of the cathedral, Amalfi, which were seen in their present position by Desiderius in 1062, given to the church by Count Pantaleone. Members of his family gave those at Atrani, S. Paolo fuori, Rome, of which only a few poor remains escaped the fire, Monte S. Angelo and Monte Cassino, the last named being practically unornamented. In these doors the figures are incised on the bronze, and the lines filled either with silver or with a coloured mastic, and some of the panels have crosses cast and chased applied to the surface which bear great resemblance to others, nearly contemporary, at S. Sophia, Constantinople. The doors of the Cathedral, Salerno, given in 1099 by Landolfo-Butromilo and his wife, are similar, and at S. Mark's, Venice, is a pair of doors of the same kind brought from Constantinople, and another pair made in the twelfth century in that city in imitation of them. These doors are all inscribed, so that there can be no mistake as to the time and place of their manufacture. At Troja are two very fine doors made by Oderisius, of Benevento, in 1119 and 1127, which combine the Byzantine technique with a feeling for grotesque and relief work, and with engraved patterns of a Western type; and at Canosa are two remarkable doors made by Roger, of Amalfi, about 1115, on which the applied flat ornament is quite Saracenic, while some of the figures were executed in the usual Byzantine manner and others cast and applied. Amalfi had a flourishing commerce in the early mediæval period. While in Salerno Arab science came in contact with Christian and that of the West, Amalfi was the centre of exchange for Eastern and Western merchandise. The Arabs brought thither Oriental manufactures and received in exchange Western products; and the Amalfitans carried Western manufactures to the maritime cities of North Africa and Syria. They also had relations with the Greek ports, bringing especially the purple robes which the Greek nobility used to wear. It became the special emporium of the silks of Greece. Amalfitans were also established in Constantinople, Sicily, and other places. The beautiful marble ambos of the twelfth century, of which this at Salerno is an example, are the product of this mingling of Oriental influences with the Lombard. It was made for Romuald the Salernitan bishop, and councillor to William I. and II. of Sicily, who spent a great part of his life in Palermo, and, no doubt, employed Saracen workmen to fulfil his commission, though the sculpture of the Easter candlestick especially shows the chisel of a Campanian sculptor. The fine doors at Benevento, of about 1150, show Byzantine influence in the design of the subjects and in many of the architectural details, but combined with a study of nature and a variety in the arrangement of poses which at first sight seem alike, which show that the design was not an affair of carrying out a receipt. The doors made by Bonannus of Pisa and Barisano of Trani, which stand near each other in the Cathedral of Monreale, show considerable feeling for relief. In the west doors at Trani and Ravello Barisano employed the same moulds as at Monreale with somewhat different surroundings, basing many of his models on the panels of the Byzantine ivory civil caskets, on which figures of warriors fighting, &c., are common. The ornament between the panels is also quite Oriental in its suggestion frequently, and this detail from the door at Ravello shows how the various pieces were combined. He was a commercial craftsman and thought nothing of repeating the same panel over and over again in the same door—indeed both in this door and in that at Trani the two leaves are repetitions of each other, and the form of the panels at the top of the door (which is square-headed) shows that it was originally designed for one which fitted within an arch—the door at Trani in fact. Bonannus also did not mind repeating the general arrangement of his door, and that at Monreale is very like that at Pisa, with the opposite fault, for Pisa must have been the original with a square head and

long panels at top and bottom ; at Monreale, part of the top panel is hidden by the arch. Herr Graeven made a curious discovery at Pesaro of an ivory of Adam and Eve being driven out of Paradise, which is identical with some little figures on Bonannus' door at Pisa, and which makes it certain that ivories were used as models by the Italian bronze workers ; and by further discoveries has shown that the ivory workers sometimes copied miniatures. He found in the Museum at South Kensington a panel with two ends added to a central portion. The centre was the reproduction of a miniature from the Joshua roll in the Vatican Library, a MS. of about 500, while two figures on the piece added to the right were taken from another miniature in the same roll. One of the panels of the cover of the Psalter of Charles the Bald and a panel in the Zurich Museum also show the use of miniatures as copies, in this case from the Utrecht Psalter; and the cover of the Veroli casket he shows to have been put together from various classical sculptures and mosaics, specially the Europa corner from a mosaic found at Palestrina and now in the Barberini collection at Rome.

The northern tradition is seen in the doors of S. Zeno, Verona, which were probably originally made in Saxony and show great resemblance to work at Hildesheim, Augsburg, and Nijni Novgorod, at which last-named place there are doors which came from Magdeburg. These doors of S. Zeno were burnt in 1160 and restored, and additions by a third hand, probably a local craftsman, may be recognised. The piercings in the dividing rolls are probably a reminiscence of the cloisonné glass and garnet work which the early Goths practised—the plate prepared for the jewels. The German influence in this part of Lombardy was very strong; it was reunited to the Empire by Otho I., and in the lists of monks and nuns on the various religious foundations names of German or Lombard derivation are far more numerous than Italian names.

Architectural ornament, both painted and carven, appears generally to have developed in accordance with the progress in the Scriptoria, though it is questionable in some cases whether the design of the goldsmiths' work influenced that of the MSS. or whether the reverse was the case. At any rate details of ornament which appear in architectural decoration in the twelfth century are to be found both drawn and worked in metal at an earlier date. At Reichenau and Ratisbon were schools of illuminators whose designs were used for wall paintings, and in the MSS. the ornamental details show the plan of Romanesque scrolls, with Byzantime forms in the accessories of the miniatures, with Lombard interlacings, and in one case at least with a development of Syrian carved patterns of the sixth century. The north door of the Cathedral of Basle, 1010-19 (to which Henry II. presented the fine antependium now in the Musée Cluny), shows ornament which has Eastern suggestion though obscured by restoration. In Frederic Barbarossa's Castle at Gelnhausen, the Oriental suggestion is stronger, the general form of the caps bearing a likeness to Saracenic shapes (as we have found also at Le Puy), coupled with the Byzantine super-abacus elaborately carved. Similar arcades to this one occur at Schloss Münzenberg, Goslar, The Wartburg (which is perhaps the finest example, having several storeys), Wimpfen, Seligenstadt, and in other castles. Frederic went with his uncle Conrad to the crusades in 1147-8, and perhaps this may account for the character of the ornament to some extent. The date is 1170, and there is a curious difference between the extreme richness and elaboration of the ornament of the archivolt of the door to the great hall and the simplicity of that applied to the fire-place. At each side is a carved panel—one has an interwoven pattern met with in Rome in the sixth century, and the other a well-known ninth century pattern of interlacings. The arch of a window opening above and the shafts of the fire-place have a simple zigzag and chevron, and if the two panels were not of the local stone one would suppose that they had been imported in the same manner as Charlemagne imported marbles for his palace at Aachen. On one of the capitals the imperial eagle appears, but it is doubtful whether it has any heraldic signification, for capitals almost precisely similar occur at Toulouse and in other places where there could be no question of imperial rule. The little town has a very fine church of rather a later date, probably about 1220, but the carving retains the Romanesque patterns in the elaborate ornaments of the jambs and archivolts, and gives a very good idea of the richness of the later Romanesque. Here you may still observe an inferiority in the treatment of the figure work to that of the ornament, and a certain stiffness of pose, though it is a great advance upon the earlier Romanesque figure

sculpture; but the carving of the ornament is excellent, and, indeed, has been styled "unsurpassable" by a German art historian.

The Cathedral of Bamberg in its present state dates from the twelfth and thirteenth centuries; the western choir was finished in 1274, a consecration is recorded in 1237, and an earlier one in 1111. To the earlier building the doors at the eastern ends of the aisles belong, one of which has a very beautiful range of capitals with half lengths of saints, forming a kind of superabaci. The other has had figures attached to the columns in imitation of the French portals at a later date; and the fine door on the north with similar figures and a Doom in the tympanum is also of this period, several of the figures being evidently carved by the same sculptor. The grimacing figures, by another hand, show that the French influence had not been fully absorbed, though the capitals are many of them quite excellent in design, but no longer distinctively German in character.

It has been claimed by some German writers that the Romanesque style was firmly established in Lower Saxony in the second half of the tenth century. If that is so, it can only have been as simple construction, for after the Ottoman impulse was exhausted the level of carving was very low until the end of the eleventh century. Many of the examples have been dated too early, and the latest German opinion appears to be that the carving on the Holy Grave chapel at Gernrode, some tombs of abbesses and other carvings in the Schlosskirche, at Quedlinberg, and the figures on the parapet of the West Gallery at Kloster Groningen are the earliest examples extant. These are all of the twelfth century. A good deal of beautiful archaistic work was done in stucco, at Hildesheim, Halberstadt, and Hecklingen for instance, with which the figures at Cividale may be compared, which are probably of the same century. The influence of Byzantine ivories is evident in the casting of the draperies, an influence which is even more noticeable in the Christ of the fine tympanum of S. Godehard, Hildesheim, of the end of the century. Herr Goldschmidt has published a photograph of this figure side by side with an enlargement of a Byzantine ivory which proves the influence incontestably. This is before the French influence appears, the earliest certain instance of which is in the choir of Magdeburg, where a craftsman who had worked in France commenced working between 1210 and 1220.

Although the most important factor in the making of Romanesque ornament has been proved to be motifs of Oriental origin, modified by local peculiarities and Lombard tradition, the influence of the antique must not be left out of consideration, though its strength varies greatly in different districts. We have seen, for instance, how much the ornament of the south of France was affected by the remains of antiquity still extant there, and at Modena the carving of Wiligelmus on the façade of the cathedral shows classical details in the moulding, and even absolute copies of a winged genius with reversed torch, used as decorative panels; but around Spoleto a school arose in the twelfth century which based its ornament so closely on the imitation of classical details, that the buildings upon which they appear have been held to be entirely antique, though it is only certain portions of them which are so. The door of S. Salvatore in Crocefisso, now the chapel of the cemetery, for instance, and the tympanum of the Temple of Clitumnus, a few miles away, both have the cross interwoven with their ornament in a manner which shows that they are not of Pagan origin—though in each case considerable portions of the building behind are antique and the character of the carving in accordance. The church of S. Pietro, Spoleto, has older reliefs worked into the ornament of its façade with bestiary subjects, but is work of the end of the twelfth century. Yet the patterns carved upon the jambs of the central door are so antique in style, that it is only the perfect fitting of the ornament to the space which it fills which makes it certain that it was carved for its place. An enlarged detail will show this character more clearly. Now it is a very curious fact that this pattern is almost exactly like the jamb of a door of the Syrian second century church of Kanawât, figured in the report of the American Archæological Mission to Syria; and it is strange and inexplicable that two sculptors so far away from each other should hit upon the same treatment of much the same details. Observe also that the rosette patterns of inlay are most of them Oriental. At Narni, the doors of S. Maria Impensole are surrounded by similar ornament which is plainly the work of the same school, the principal of which, the main door of the Cathedral, Spoleto, is signed by Melioranzo, who perhaps was the founder. At Verona too, classical details are frequent. The arcaded cornice of the font in S. Giovanni has among

the heads which serve as corbels a Jupiter Ammon with ram's horns, a Midas with ass's ears, and a head of Zeus. And at Pisa, the pillars at the sides of the central door of the western façade are covered with elaborate arabesques which are so antique in feeling that they too have been claimed as antique fragments though the proportions of the columns are not antique, and the corresponding columns of the door of the baptistery are worked with equally beautiful arabseques, the work of Diotisalvi in 1153, while Guido Bigarelli of Como's font in the centre shows a combination of inlay of coloured marbles mixed with foliage, in which the antique influence is often very visible, though the carving on the lintels is inspired by Byzantine ivories. At the Cathedral of Lucca are other columns with beautiful arabesques based upon classical data, and in the lovely cloister of Monreale, Sicily, one of the most beautiful features is the groups of four colonnettes at each angle carved with similar arabesques.

Again, the scrolls of ornament on the doors of the Cathedral, Zara, are based on classical forms, though indirectly, and they bear great resemblance to those used by Benedetto degli Antelami on the archivolts of the doors of the Baptistery at Parma, and a still closer resemblance to the ornament on the font within. At Borgo San Donino, he used the same kind of details, which themselves are very like the carving directly derived from antique models which we have seen at Arles and S. Gilles, and make it pretty certain the Benedetto had lived and worked in the South of France. Certain details of costume (such as the curious cap, which is also found on a terra cotta dug up at Afrosiab, near Samarcand) and ornament occur in France, and not at all in Italy at any earlier period. His most evident use of the antique is in a figure of a griffin, which is taken almost line for line from a well-known antique, but vivified.

It was probably from the sarcophagi that the arcadings with figures or ornament beneath them, which occur as part of Romanesque decoration, originated. Such compositions as that from the western façade of the cathedral at Modena, in which subjects from the history of Adam and his family fill a series of arched spaces, and form a decoration on either side of the main doorway, are not infrequent. At S. Zeno, Verona, the arched spaces contain a greater variety of subjects, in four rows, each beneath a single arch, ranging from the Creation to the legendary death of Theodoric, with patterns on the bands between, evidently of classical origin; and in the columns of the high altar at S. Mark's, Venice, probably brought from S. Maria in Canneto, Pola, and dating from the fifth century, a whole series of Scripture subjects is treated in this manner, one figure generally tenanting each niche, which makes them rather difficult to comprehend when many figures are required for the expression of the subject. This rather inconvenient method of rendering scriptural and legendary subjects was sometimes used at a later date; the similar pillars at the back of the canopy at San Marco are of the eleventh century, though very inferior in workmanship to those which they imitate; and in the courtyard of the Archbishop's palace at Verona is a column of a later period, as the trefoiled arches show, carved with scrolls with very decorative effect. It was in fact the decorative effect which was sought rather than the effective presentment of the subjects: in such arcadings ornament is often found in place of figures, as in the well-known well-head from S. Samuele, Venice, in which the Byzantine character of the ornament is so pronounced.

There is no doubt that the subjects which the ornamentists used were, to a great extent, symbolical, though enthusiasts have very much exaggerated the amount of intentional symbolism used by the Romanesque, if not by the mediæval architects and designers. Many forms which originally had definite symbolical meaning, with the lapse of years and transference from one country to another, lost that meaning and became merely decorative details, to be used as convenient. A very good example of this is the "hom," the sacred tree of the Assyrians and Persians. This, in the hands of the Byzantines, lost all symbolic meaning, and in European designs derived from Oriental patterns, became merely a decorative detail, as in this window from Santa Maria, Pomposa, in which the griffins are equally without symbolic meaning. Certain Old Testament subjects were often used to symbolise Christian mysteries. The months and their labours, the signs of the zodiac, as at S. Mark's, Venice, at Autun and Vezelay, round the arch, and sometimes heathen personifications are constantly found, and, of course, figures of saints, angels, apostles, and prophets, the symbols of the evangelists, the Agnus Dei, &c. Plants were also used symbolically, of which the one most frequently occurring is naturally the vine. The rivers of Paradise, at which stags fre-

quently are drinking, and the corresponding birds, generally peacocks, drinking from a vase, and the cross of various shapes everywhere. The Psychomachia of Prudentius furnished impersonations of virtues and vices, and the subject of their contest occurs on pavements, and was probably the origin of the popular triumphs of love, chastity, death, &c., at a later period. The bestiaries and early epics were also drawn upon for subjects. Dragons, griffins, and other fabulous monsters occur frequently, and the lion is found with most opposite meanings attached to his appearance. The explanation of these various symbols has been the occasion of much very fine and informing writing; but, while it is possible to make tolerably certain of the general meaning of the symbolism of the ornament upon a building, the fact that many of the details are copied from or suggested by other works, makes it doubtful whether much benefit attaches to the attempt to unravel the symbolism in minute detail. It is much more likely that the craftsman concerned himself merely with the appropriateness of his ornament to place and material than worried himself with its symbolic meaning in the first place; and in smaller works it is still less likely that the symbolism came first, if one may judge by the habits of the craftsman of to-day. In the case of an enthusiast it might be so, but enthusiasts have never been in the majority; in such works as those conceived by S. Bernward and executed either with his own hand or under his direct superintendence, for instance, it is possible that everything may have had a symbolical meaning; for we know that he planned S. Michael's, Hildesheim, with a definite intention, dedicating the building to the Holy Trinity and the Nine Choirs of Angels. It had three naves of three squares, and east and west lay a transept, also of three squares; but I entirely decline to believe that the feeling for symbolism had so permeated the nations of the West as to make it easy for the average public to read obscure symbols, even if it be assumed that the designer used his forms with a definite symbolic meaning. Symbols to be intelligible must be familiar, and therefore trite; a fresh symbolism is necessarily unintelligible, or at least uncertain in meaning. On these capitals from the Cathedral, Autun, are seen the subjects of Androcles and the Lion, S. Hubert or S. Eustace's conversion, the Presentation in the Temple, and Balaam stopped by the Angel. On the other side are the fable of the Stork and the Wolf, the Baptism of Christ, and a Warrior on a Griffin —a very curious mixture, the explanation of which on a definite symbolic plan appears to be difficult.

RADIUM IN THE ROCKS OF THE SIMPLON TUNNEL.*

The principal classes of material which enter into the composition of the massif of the Simplon are: (*a*) The Jura-Trias sediments, lithologically often much alike and much interfolded; (*b*) the Palæozoic crystalline schists; and (*c*) the gneiss of Monte Leone and the Antigorio gneiss, both stated to be of Archæan age. These rocks throughout contain radium, and for the most part in quantities much above what hitherto has been ascribed to sedimentary or igneous rocks.

Some thirty-six typical samples, taken from various points in the tunnel, have been examined. The poorest in radium are certain anhydrite rocks. Certain amphibolite schists go very high. The Antigorio gneiss rises from $10{\cdot}5 \times 10^{-12}$ and $8{\cdot}0 \times 10^{-12}$ grams radium per gram of rock at the Italian entrance to $23{\cdot}7 \times 10^{-12}$ at 4,000 metres inwards. Some of the Archæan gneisses yielded very high results.

Such quantities of radium if generally distributed throughout the rocks of the massif would be sufficient to disturb any forecast of the temperature which under normal conditions would be encountered at the level of the tunnel. It is suggested that the radium was in fact the source of the discrepancy between the predicted and the observed rock temperatures.

As it is improbable that these results are unique and apply only to this particularly sedimentary accumulation and locality, they appear to point to hitherto unsuspected quantities of radium (and its parent elements) in the immediate surface materials of the earth. It seems impossible to avoid the conclusion that these elements were precipitated along with the sediments entering into the composition of the massif. The question then arises whether the accumulation of such quantities of radioactive elements may not enter as a factor in the events attending mountain-building. It can be shown that an area of sedimentation whereon has been accumulated some 10,000 metres of sediments, having a richness in radium comparable with the Simplon rocks, must necessarily become an area of greatly lessened crust-rigidity, and would hence become the probable site of crust-flexure under tangential compressive stress.

Further investigation will be required before such views can be generalised and the importance of

* Abstract of paper read by Professor J. Joly, Sc.D., F.R.S., before Section C of the meeting of the British Association at Leicester.

radium as a source of instability of the earth's crust be determined. Apart from any speculations as to the influence of radium as the cause of an energetic substratum, the shifting of radium and its parent elements by denudation must be regarded as a convection of thermal energy, and this convection, if the quantities involved are sufficient, must, under the conditions referred to above and the unceasing action of denudation, become rhythmic in operation, and at the same time must result in shifting the areas of high temperature and crust-weakness from age to age as the site of sedimentary accumulation changes.

THE TRAINING OF AERONAUTS IN FRANCE.

There is in France, strictly speaking, no school for the training of aeronauts and construction of air-ships in which a definite and prescribed course of study or lectures is pursued. Such instruction and practice in aerostation as are offered are provided by clubs, and by the Government in connection with the military service. There are in Paris four rather important aeronautical societies or ballooning clubs, and five similar organisations elsewhere in France. These clubs were established for the promotion and practice of ballooning as a sport, as well as for scientific study and experiment, and in general for the encouragement of all that pertains to aerostation. In some of these young men are given practical training, taught the theory of construction, and use of balloons, and instructed practically concerning balloon materials and parts, such as the net, anchor, basket, the guide rope, valves, the tying of ropes, knots, &c., the preparation of a balloon for an ascent, and the care and return of the material after descending. Under certain circumstances these pupils—who are always members of the club—may take part in the ascents, learn how to handle the balloon in the air, and descend under different conditions of daylight and weather. If they acquire a certain efficiency in all this, and pass a prescribed examination, they are permitted, when drawn from military service, to enter the "Bataillon d'Aerostiers," or balloon corps of the army. This batallion is established, according to the American Consul-General in Paris, in what is known as the "Menagerie," the old Zoological Garden, formerly belonging to the palace and park at Versailles, and situated between that city and the military school at St. Cyr. Formerly these bataillons d'Aerostiers were distributed throughout the provinces, but since 1870 the Government has concentrated them at the "Menagerie," and they form part of the regiment of engineers garrisoned at Versailles. The post is under the control of a commandant, and the men are taught and practise the handling and care of balloons, of which there are in use several of moderate size, none with a capacity exceeding 900 cubic metres. Besides the balloons, the apparatus and material necessary for inflating them, the equipment includes a plant for making hydrogen gas, which was formerly exclusively used for inflation, but more recently illuminating gas on account of its more moderate cost has been generally employed, especially for free ascents. Most of the ascents made there are with captive balloons. The men who enter this branch of the service are trained at the annual manœuvres for active duty in case of war. Their teaching is practical, and includes all that pertains to preparing, loading, unloading, inflating, deflating, packing up, transporting, &c., but they make no ascents. This is the exclusive duty of officers. Their service lasts ordinarily two years, when they are discharged, subject for call to duty in the military balloon corps in case of war. The main incentive to service at the "Menagerie" is that it offers a less arduous form of duty than ordinary service in the ranks, and, moreover, keeps the young recruit within convenient distance of Paris; but many of the young men have no special gift for the management of a balloon, and opinion among experts is somewhat divided as to whether most of them learn much that would really be useful in the event of actual war.

The second, and far more important institution of this kind in France, is known as the "Etablissement Central du Matériel de l'Aerostation Militaire" at Chalais, Meudon, about midway between Paris and Versailles. It has been in existence nearly a hundred years, and is divided into two general departments, as follows:—1. The arsenal, at present under the command of Commandant Bouttiaux, at which are manufactured balloons and every form of balloon material and equipment for use of the aeronautic service of the French army. 2. The Department of Tests and Experiments, under command of Lieut.-Colonel Bertrand, where new inventions are developed and tests made with gas and every form of material and appliance which pertains to military aeronautics. The institution is in fact a combined arsenal and experimental station, but it is in no proper sense a school, since it has no definite course of instruction, no text-books or specified course of lectures. It is there that the official experiments in aerostation, tests of new materials and original features in construction are made by military experts. It was there that Colonel Renard, twenty-three years ago, built and experimented with "La France," the first dirigible balloon. These two institutions, the "Menagerie" training camp near St. Cyr, and the arsenal at Chalons, are the two principal Government stations for balloon materials in the neighbourhood of Paris. There are besides, several minor depots of such material at military posts near the frontiers, where it would be promptly available in case of war. It is moreover known that two of the French army corps are provided with large dirigible balloons of the Lebaudy type, built for the purpose by the Lebaudy Bros., who also trained at their works the first soldiers who were instructed in inflating and navigating them.

HOME INDUSTRIES.

New Cotton Mills.—Notwithstanding the very general impression that the time is near when there will be much less activity in the cotton trade, and the great number of cotton mills recently erected, the readiness to build new mills continues, as no doubt it will until the period of depression has actually and visibly arrived. But, however anxious speculators may be to build, they are checked by inability of machinists to deliver. Not only is it impossible to induce machine makers to bind themselves to deliver machinery to new mills by a fixed date, they are unable to deliver for existing mills at due date. A partner in one of the largest textile machine making firms in Lancashire has just told an interviewer that his firm have quite recently refused to take an order for six new mills for ring and mule spinning, because "they want to have the wheels going within two years, and it is impossible under present circumstances." It is surprising that there should be any such demand for mills under present circumstances. Not only is the cost of building and furnishing a spinning mill at the present time from 30 to 50 per cent. higher than it was two years ago, unless the precedents of the past are to go for nothing, before new mills can be in working order, any way before they can be running long enough to make anything for shareholders, Lancashire will have to face once more the lean years that hitherto have invariably followed fat ones. Meantime, there are many factories already built, and fitted with engine and gearing, standing idle because preparing and spinning machinery are lacking. The promoters complain that machinery that should now be earning a profit is not even delivered. The machinists guard themselves against actions for damages by refusing to bind themselves to complete orders on any given date. They are very pleasantly placed just now. They are getting very high prices for spinning plant, they are full of orders, and they are under no penalties to complete by any given date.

The Making-Up Trade.—The new Australian tariff is in some respects less favourable to British trade than was hoped. Preference is indeed given to British goods, but it is a preference that may not have much substance in it. The tariff, as might have been assumed, thinks first of Australian industries and how best to protect them. As between the British trade and the foreigner the Commonwealth Government — unquestionably reflecting public opinion—desires to favour the Mother Country, and has done so, but where it becomes a question of a local industry naturally the first consideration is given to that industry, as in the Dominion and elsewhere. Thus the new Australian tariff on wearing apparel is to be 45 per cent., and it is believed among makers-up that the preference in favour of British goods will not prevent the growth of the garment manufacturing industry in large Australian towns. For some time past the shirt, apron, blouse, and allied industries have been developing in Melbourne and Sydney, where they have been actively encouraged by the principal drapery houses, who in some cases run factories of their own. The new tariff is so framed as to encourage the growth of the making-up trades, since while the duty on apparel is high that on cotton and linen piece goods is only 10 per cent. Woollens are taxed higher because in this department of textile production Australian manufacturers have made some little progress. It is believed that the new duties will accelerate the tendency towards an increase of the Australian piece goods trade at the expense of the ready-made business. Already the change is said to have exercised a depressing influence upon garment manufacturers which is the mainstay of many departments of the export trade.

Motor Omnibuses and Speed.—Mr. Thomas Browett writes to suggest the advisability of the Board of Trade insisting that motor-cars shall be fitted with an automatic controller to prevent their running above a maximum speed under any conditions. Mr. Browett recalls that a quarter of a century ago, when steam trams were first introduced into Birkenhead, a firm designed a device said to have been successful for the purpose. There would, he thinks, be no difficulty in fitting a similar device to meet all the required conditions in the case of the motor omnibus such, for instance, as momentary acceleration to enable traffic to be negotiated. It would seem desirable that all motor omnibuses should be required to use some such apparatus to keep them within the limit of twelve miles an hour, a speed quite fast enough for such heavy vehicles on public roads constructed and maintained at the public cost. The omnibuses themselves, as well as the roads and adjoining property are shaken to pieces by the high speeds now common, to the great loss of all concerned. The adoption of such a check would also go far to stop racing for traffic which is now of constant occurrence. The cost of the apparatus should be small, and something would be done to lessen the great loss to private property consequent upon the advent of the motor omnibus. It may be hoped that the authority responsible for London traffic will give early attention to this question of motor omnibus speed, and how best to regulate it. Questioned as to the use of the controller the Home Secretary, in reply to Mr. Harold Cox, said that there is no such contrivance actually in use but that whenever such an apparatus is available the Chief Commissioner of Police will carefully consider the question of requiring it to be fitted to motor omnibuses in the metropolis. It would be interesting to know what has become of Mr. Browett's apparatus.

Old Age Pensions.—The High Court of Foresters, meeting at Leeds last week, came to an important decision. They decided to send forward an instruction to the incoming executive council to submit to the Northampton High Court scales of contributions

for a compulsory superannuation benefit for all future entrants into the society. At present a large number of members receive what is practically an old age pension under the designation of sick pay. Legally, there is only the right to sickness benefit when sick; in practice, the help is often extended to old age. It is now proposed to provide that new entrants be required to pay for a pension at 5s. per week, to commence at the age of 70, in lieu of sick pay. The supporters of the resolution do not desire that the Government should take it as a reason for not pressing on with their scheme of old age pensions. The wish is not to supplant the Government, but to provide the machinery to enable friendly societies to supplement what would come from the Government. Probably, if the pioneers of the Foresters could have foreseen that thousands of old men in the Ancient Order of Foresters would draw pensions from the sick and funeral fund they would have endeavoured to frame their contributions so that the full liability would have been met. "There was no more painful matter," said the Permanent Secretary, "in connection with their Courts than when an old man, unable to work, but yet not suffering from specific sickness, was refused sick pay," and the only way to meet cases of that character "is to set up a pension fund in connection with every Court." It is proposed to pay the pension to the member whether well or ill, and he will not be debarred from working if he so desires. In the opinion of some members the age of 70 is too high, but experience is said to prove that of every 100,000 members who join at eighteen, 33,503 are alive at 70, and the average duration of life after that age is $8\frac{1}{3}$ years. For a pension of 5s. a week at 70, the additional cost at the age of eighteen is 4s. 11d. per annum. Roughly, it may be said that by taking the age 70 of instead of 65 as the pension age the cost is reduced by one-half. It may be noted that the delegates of that large organisation, the Hearts of Oak Benefit Society, also meeting in London last week, passed a resolution that the Board, "whilst trusting the Government will be able to introduce a scheme of old age pensions which will include all persons, fully recognise the difficulty in doing so, and in the first stages of such a great reform, would strongly impress upon them that, through the friendly, labour, and organised registered societies, they would find a large number of persons deserving of State pensions, who, by the fact of having joined societies, prove generally their deserving character, and would respectfully submit to the Government the practicability of founding their scheme firstly through the present organised channels.

The Coal Industry.—The continued rise in the price of coal is a very serious matter for home industries, and probabilities point rather to further increase in prices than to reduction. To the railways of the United Kingdom alone the recent advances in the price of fuel means a prospective additional expenditure of from £1,750,000 to £2,000,000 in the current railway year. And the bearing of the continuous rise in coal prices on the general manufacturing industries of the country is most serious. Miners wages are being advanced all over the country. The Northumberland miners have just been granted another 5d. per day and the Scotch miners are asking for a further advance of $12\frac{1}{2}$ per cent. on the standard, and for a raising of the basis rate of minimum wage from 4s. to 6s. per day. The wages of miners, it must be remembered, are regulated by the coal market. As prices rise so do miners' wages. It is to be noted that the advances in coal have not as yet affected exports, indeed it is the foreign demand for steam coal that is the chief cause of the general advance. Last month 20s. was an extreme price for best Admiralty qualities, but since then there has been an advance to 21s. 6d. to 22s. 6d. The holidays may have had something to do with it by lessening the Welsh output, but there seems to be scarcity in the supplies available for waiting tonnage. The shipments from the Welsh shipping ports this year have exceeded previous records, and there are no signs of abatement in the demand. Some of the Welsh railways have covered themselves in Monmouthshire coals up to May next at advances of 3s. 6d. per ton on expiring contracts. The chief increase in the export demand for Welsh coal has come not from Germany,—the German demand having gone to the North of England and Scotland,—but from France, South America, and Egypt. In the north of England an unprecedented amount of tonnage is said to be waiting for cargoes. Freights are low, and cheap carriage has enabled exporters to secure an abnormal amount of foreign orders for both Northumbrian and Durham coals. In Lancashire the demand for coal is so great that the collieries have had difficulty in meeting it during the holiday season. All over the country the coal markets have been active in what is usually the dull season, and the activity is for home as well as foreign requirements. Then there is the increase in the item of railway charges consequent upon the railway companies ceasing to carry for coal owners $20\frac{1}{2}$ cwt. of coal for one ton. This means a future increase in the railway freightage, and, therefore, of the cost price of coal. The Eight-hour Bill cannot become law this year, but it is quite probable that it will next, and should it do so it can hardly fail to raise the cost of production. Altogether the outlook for the coal consumer has seldom been less favourable, or less likely to improve in the immediate future.

CORRESPONDENCE.

EFFECT OF IRRIGATION ON ALKALI SOILS.

In the discussion upon Mr. L. Robertson's most interesting paper, "Irrigation Colonies in India," an inquiry was made by Mr. H. S. Lawrence on that important point, "What was the effect of irrigation

on alkali soils?" to which very vague and inconclusive answers were given at the meeting. So very vague and inconclusive was the information given, that it seems a suggestion by an outsider may at least afford grounds for some real information being given. All the eminent irrigation engineers who spoke in the discussion agreed that irrigation conferred so great benefits that the effect, whatever it might be on alkali soils, may be disregarded as an argument against irrigation on a large scale. All evaded or avoided answering the question directly. We were told that in the Chenab colony there was no sweet drinking water in the country before the advent of the canal water, and further, that the well in Lyallpur, which was once brackish, had much improved in quality with the flooding of the surrounding lands. We were also told that in Egypt land had been made free of alkali and fit for cultivation by being drowned under three feet of water. These were the only two facts brought up at the meeting, and there being only two mentioned implies a dearth of facts on this important point.

There are so many interesting matters in connection with the inquiry, that I must confine myself to making a suggestion directly answering it. I suggest (1) that the effect of irrigation on alkali soils which have no "pan" near the surface, and below which the subsoil water-level is at a considerable depth, is, by forcing water, which by gravity filters through the soil downwards, to diffuse or disseminate these soluble salts and alkalis through the lower soil and so sweeten the surface soil, which had heretofore, in a dry country, been the recipient of the soluble salts and alkalis left behind by the water drawn up and evaporated during the long periods of drought to which such countries as the Central Punjab and Egypt are subject. (2) The effect of irrigation on soils which have a shallow-seated "pan" is, by bringing on water which always carries soluble salts in small quantity, to add to the total of salts carried by such shallow beds of soil and in time to render them unculturable. To sum up, irrigation can only be beneficial to deep soils with no "pan" and subsoil water at a depth: and it must always in time be detrimental to alkali soils underlain at a shallow depth by a "pan" or subsoil water.

C. M. P. WRIGHT.

Srinagar, Kashmir,
12th July, 1907.

OBITUARY.

EARL OF CLANWILLIAM, G.C.B., K.C.M.G.—Richard James Meade, fourth Earl of Clanwilliam, Admiral of the Fleet, died of pneumonia on the 4th inst., at Badgemore, Henley-on-Thames, after a brief illness. Lord Clanwilliam was born on October 3rd, 1832, and after having received his early education at Eton entered the Navy in November, 1845. In 1854 Lord Gillford (as he then was) became a lieutenant of the *Impérieuse*, and served in her during the whole period of the Russian War. He was severely wounded at the assault on Canton, 1857, became Commander in 1858, Captain 1859, Rear-Admiral 1876, a Lord of the Admiralty 1874-80, succeeded his father as fourth Earl in 1879, became Vice-Admiral 1881, Commander-in-Chief North American and West Indian station 1885-6, Admiral 1886, Commander-in-Chief at Portsmouth 1891-4, Admiral of the Fleet 1895, and retired in 1902. Lord Clanwilliam was elected a member of the Society of Arts in 1891.

GENERAL NOTES.

COTTON AND RUBBER IN UGANDA.—The outlook for these products in the Uganda Protectorate appears to be promising. In his report for the past year, just issued, Mr. Hesketh Bell says that the exports of cotton amounted to about 43 tons only, but nearly 200 tons were purchased from the natives, the result of little more than a year's effort on commercial lines. There seems to be a likel[illegible] culture of cotton becoming a national indu[illegible]. The earlier methods of cultivation were crude [illegible] imperfect. American upland cotton is the most [illegible] genial to the climate and country, and the natives are beginning to grow it extensively. Egyptian Abasic cotton also thrives, though to a lesser extent, and samples of both kinds sent have brought 7½d. and 7d. per lb. As to rubber, tests are going forward. Mr. Bell says that a Para rubber tree, 4½ years old, is 27½ feet high, with a girth of 12½ inches four feet from the ground. About 200 trees, 2¼ years old, grown from seed, are 17 feet high more or less. There has been considerable commercial activity with regard to the product, and ventures on a large scale are said to be pending.

RAISING OF GALVESTON.—Reference was made in these notes last year to Mr. Consul Nugent's remarks upon the level raising of Galveston, and he refers to the matter again in his report just issued (Cd. 3283). As regards the town proper he says good progress has been made since he reported a year ago with the work of raising the level of Galveston protected by and in proximity to the sea-wall. The total quantity of sand filling called for by the contract for the town is 10,470,000 cubic yards, whilst the filling to be done in addition by private-owners brings the total amount up to some 14,000,000 cubic yards. This covers some 426 city blocks, and necessitates the raising from three to ten feet of approximately 2,500 buildings, ranging from small wooden cottages up to brick and stone churches. It is estimated that it will require about two years longer to bring the work to completion. The method employed for the filling by the contractors is to use a canal excavated on the land side of the sea-wall, by means of which dredges containing sand from the bottom of Galveston Bay are enabled to discharge their contents through pipes extending to the portion of the town to be raised.

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FRIDAY, AUGUST 23, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

FOTHERGILL PRIZE.

FOR LIFE-SAVING APPARATUS FOR USE IN NOXIOUS ATMOSPHERES.

The Council of the Society of Arts are prepared to award, under the Fothergill Trust, a Gold Medal, or a prize of £20, for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious.

It is intended that the apparatus sent in shall be submitted to practical trials and tests.

In the award of the Medal regard will be had, firstly, to excellence of design and contrivance, and, secondly, to excellence of manufacture. Credit will be given to such parts of the apparatus as are the invention of the exhibitor; the object being to distinguish the apparatus which gives the best promise of being practically useful.

Inventors intending to compete should send in a notice of their intention, together with a full description of their inventions, not later than 31st March, 1908, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.; and in cases in which the apparatus has been put into actual use, the experience of such use should be given, and the special points of merit of the apparatus indicated.

Notice of the place to which the apparatus is to be sent will be subsequently given to those competitors whose apparatus the judges may desire to test, together with an indication of the tests, and of the manner in which they will be conducted.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

ROMANESQUE ORNAMENT.

BY F. HAMILTON JACKSON, R.B.A.

Vice-President of the Society of Decorative Designers

Lecture III.—Delivered March 11, 1907.

I have observed that in matters archæological the view which a writer will take upon the origin of any forms or artistic tendencies may generally be divined by noting his nationality. If it be a Frenchman who is writing he will find French influence everywhere, the German sees German turns of expression in places where others are blind to them, while the Italian discovers the origin of the most diverse forms of expression in the genius of his nation. It is with some amusement that I find myself treading the accustomed path, and recognising that at the commencement of the mediæval period the English were so far in advance of other nations in the matter of ornament as to make it probable that English influence was one of the great factors in the genesis of my subject. In Northumbria, which Prof. Maitland said was for a while a centre of light not for England only but for the world, and Cumbria, there are important remains of carving of considerably earlier date than the Norman invasion, but in nearly every county

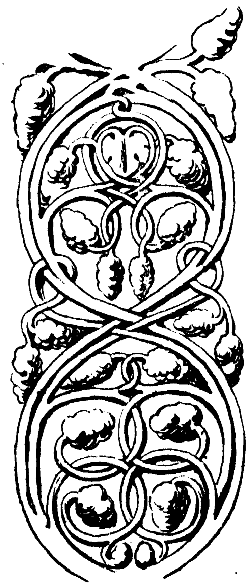
in Great Britain some piece of ornament of pre-Norman date has been discovered. The fragments in the cathedral library at Durham are nearly all Anglian, and may be due to Englishmen working with the Italians who were brought to Northumbria in the latter part of the seventh century, or to the Italians

FIG. 16.

PATTERN FROM ORMSIDE CUP, MUSEUM, YORK.

themselves in the cases of the most accomplished pieces of carving. In the celebrated Bewcastle cross, which Dr. Stephens dated 670 from the runes upon it, the knowledge of the figure is very superior to other work of the same time, and points to a foreign workman, as does the repoussé pattern upon the Ormside

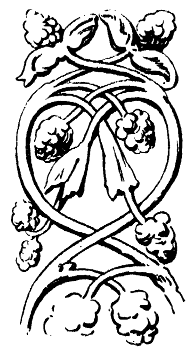
FIG. 17.



PATTERN FROM BEWCASTLE CROSS.

cup (Fig. 16) in the museum at York, the inner bowl of which is decorated with Anglian interlacing work, bosses, and precious stones. The scroll-work upon the Bewcastle cross (Fig. 17), the similar cross at Ruthwell, and the Acca cross, of which fragments are in the library at Durham, is based upon a conventionalisation of the vine, with many interlacing stems and a strong classic feeling in the foliage. At Palmyra, upon the jamb of a door is an elaborately knotted vine pattern, with two bunches of grapes hanging in the middle and two leaves breaking the main curve above them, which reminds one of the Anglian crosses, but shows more license of curve. Acca was Bishop of Hexham after Euta, who succeeded Wilfrid; he died in 740, and the chronicle says that "exquisitely carved crosses were erected at the head and foot of his grave (Fig. 18). The evidence with regard to dates suggests that the Northumbrian crosses (upon which panels of interlacings also occur) preceded those in Ireland, and it has been held

FIG. 18.



PATTERN FROM ACCA CROSS, LIBRARY, DURHAM.

that the interlacing patterns were learnt from Lombardy, which seems likely enough, seeing that we know Italian workmen had been in England. It was in Lombardy that they were used early in the seventh century, as, for instance, upon the pectoral crosses which have been found upon the Lombard graves, upon a cross in S. Giuliano de Budrio, near Bologna, and many similar carved crosses; while the use of such details as the Triskele, which is so frequently found on the Anglian crosses in conjunction with other interwoven patterns, lingers, as on the covers of a Gospel book at Vercelli, which has the name Berengarius upon it, and is probably of the tenth century, but has scrolls in the border, which show forms developing towards the typical twelfth century arabesques.

There are no Irish MSS., metal-work, or ornamented gravestones which can be safely and certainly dated earlier than 700. On the other hand, the Lindisfarne Gospels, the most ancient illuminated MS. with a really reliable date in which the

so-called Celtic ornament appears, has miniatures in which the hair of the figures is curled in the Byzantine mode, while the names of the Evangelists are in Greek, with a few errors, and among the diaper patterns is one like the Roman geometrically pierced transennæ. It bears an inscription in an English tenth century hand at the end of the Gospel of St. John, which gives the names of the makers of the volume, Eadfrith, Ethelwold, Billfrith, and Aldred, all Saxon names. Eadfrith, who was the scribe, was

FIG. 19.

ORNAMENT FROM SAXON MS., CORPUS CHRISTI, CAMBRIDGE.

Bishop of Lindisfarne between 698 and 721; Ethelwold, who bound the book, was bishop from 724 to 740. There is no sign of immaturity in the work; everything is delicately, decidedly, and beautifully drawn, especially the heads of the zoomorphs. S. Wilfrid employed Italian masons to build his church at Hexham, which was elaborate in design and decorated with painting and sculpture, and Benedict Biscop brought workmen from Gaul. Together with the foreigners, Theodore of Tarsus and Adrian, they were at this time busy introducing new rites and fashions, and establishing in the religious houses of the Anglo-Saxon Church a taste for art and literature. The Northumbrian Church gave up the Celtic customs as to the celebration of Easter, the tonsure, &c., in 664, and conformed to the Roman usage, the result of which was,

FIG. 20.

that the Scots Bishop of Lindisfarne, with his monks, shook the dust of England from the soles of his feet and returned to Iona rather than accept what he thought to be rules inconsistent with the Church of the Apostles and mere innovations of the Bishops of Rome. The new churches were of stone, "in the Roman style," in contrast to the plain timber

FIG. 21.

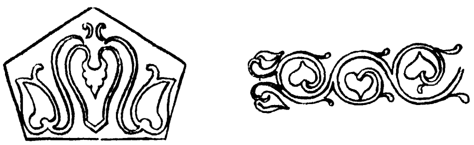
ENLARGED DETAILS OF THE SAME.

fabrics built on Scottish models, and were adorned with sculptures and paintings, which were sometimes imported from Rome, as Bede says, in his life of Eddius. MSS. were also brought, specially by Benedict Biscop and Acca, who erected a "most noble library."

A MS. of Bede's life of St. Cuthbert in the Parker Collection of Corpus Christi, Cambridge (Figs. 19, 20, and 21), has borders which are almost Renaissance in design, so plainly are they based upon classical

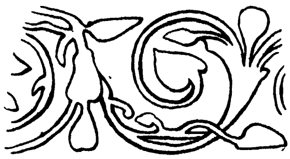
models. It is proved to be of the tenth century by the list of archbishops at the end, which terminates with Wulfhelm, who died in 923, as far as the original entries are concerned. Another hand continues the list from Odo, and Archbishop Parker completes it to his own time. The miniature which the borders surround represents a king making an offering to S. Cuthbert, who stands in front of a church; the same colours are used in both. It is believed that it is this kind of work for which the north of England was celebrated in the time of Alcuin (741-80). The "capitula" in the Lindisfarne book contain particulars which refer specially to Naples, and which prove the presence of a South Italian MS. in the library at the time it was written, probably brought by Adrian, abbot of Nisida, near Pozzuoli, who accompanied the Greek Theodore in his mission to Britain in 668. Bede says they went to Lindisfarne. On the carved fragments at Durham the divergent spiral, so characteristic of Irish work, does not appear, while a fragment from Hexham has the "caulicoli" which are common in eighth and ninth century work, as in the bishop's seat at Grado, now on the screen.

FIG. 22.



ORNAMENT FROM PYRMONT PATERA.

FIG. 23.



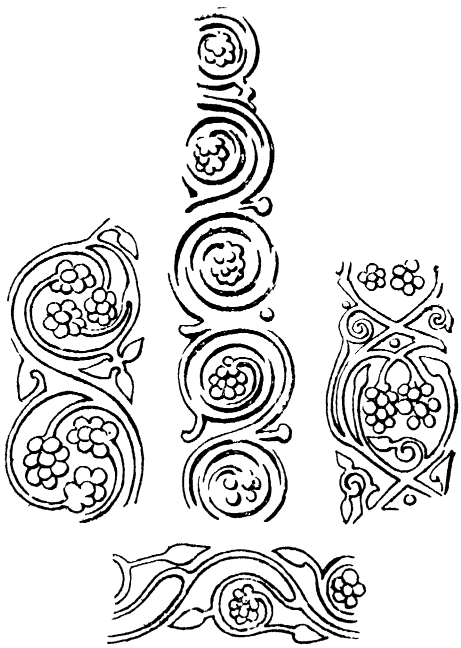
ORNAMENT FROM BRITFORD CHURCH, NEAR SALISBURY.

I have put together a few examples which prove conclusively that the Anglian work was based upon Italian data. These include ornaments from the patera of the third century found at Pyrmont (Fig. 22), a piece of carving from Britford church, near Salisbury (Fig. 23), a panel from an Anglian cross at Nunny Kirk (Fig. 24) which has Hexham patterns at the front of it, with birds and beasts facing each other within the scrolls, fragments from Lancaster and Kendal, ornament upon a vase of the Esquiline treasure (Fig. 25), silver-work with a strong Syrian or Alexandrian flavour (Fig. 26), which is of the fourth or fifth century, and a piece of Samian ware found at Buxton

FIG. 24.

ORNAMENT FROM CROSS AT NUNNY KIRK.

FIG. 25.



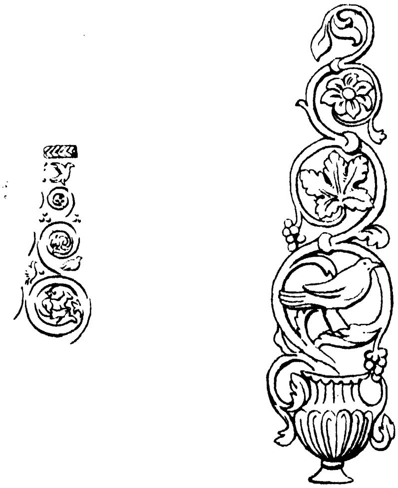
ORNAMENT FROM FRAGMENTS AT LANCASTER AND KENDAL.

(Fig. 27), with a pattern apparently inspired by metal work.

At Barnack is a pierced window slab, similar to a wooden mid-wall slab which was found in 1869 at Birstall, near Leicester, which bears such likeness in its pattern to others of the

same period scattered up and down Europe, as to render it in the highest degree probable that the various workmen or designers were connected by some bond. You will see on this diagram and the next one three types of pattern (Figs. 28 and 28*a*), one based upon lines cutting at right angles, one upon a mixture of curves and straight lines, and one upon curves solely. In Spain, at Kairouan, in Istria, we find patterns which might come from the same building. In Apulia, in Istria, and England, in Jerusalem, Venice, and Kairouan again, other forms occur with the closest relation to each other, and the step from the freer examples to the beautiful panels from the tomb

FIG. 26.



ORNAMENT FROM VASES IN THE ESQUILINE TREASURE.

of the dogaressa Michieli, in the atrium of S. Mark's, Venice, is a very short one. For the earlier forms at least we may find the requisite connection for the greater portion of the places in the Guild or Society of Craftsmen, called in the laws of the Lombard king Rotharic, "Magistri Comacini." They were largely recruited from the natives of the mountainous district in which the Italian lakes are situated, and in Como itself tolerably early examples of their work may be seen. The jambs of the east door of S. Fedele appear to be fragments of an earlier building, and ninth century patterns are worked into the eleventh century basilica of S. Abbondio. Como was in the patriarchate of Aquileia, and in the cathedral of that city are some very fine slabs of the eighth and ninth centuries. The patriarchs fled to Cividale when the Hungarians came ravaging into Italy, and here, too, are remains of the work of the Comacines. The original font made for Calixtus in the eighth century, though much altered (for it was intended for total immersion) is preserved in the cathedral. In the spandrils are figures of birds and other creatures, rudimentary plant forms appear with rosettes and other Oriental features, which show that the process of welding together diverse influences had commenced. The Croatian *bani* made pilgrimages to Cividale in the ninth century, and took Comacines back with them (as being the best ornamentists to be found, one may suppose), and thus the style spread down the eastern coast of the Adriatic. These panels, now in the museum of S. Donato, Zara, show how closely the style of the different works corresponded, wherever they were executed. At Ravenna one finds the same kind of patterns carved at this period, and sometimes with great delicacy and beauty, as in the canopy of the altar of St. Eleucadius in S. Apollinare in Classe. The convention

FIG. 27.

PATTERN ON SAMIAN WARE FOUND AT BUXTON.

for the bunch of grapes used here occurs over a very wide district and is met with in Visigothic carvings in the middle of Spain. These patterns are found further south on the Italian coast, while from Milan and Pavia, which was a Lombard centre, they spread to Toscanella, Viterbo, the frontier town of the Lombards towards Rome, to Rome itself, and further south along the western coast of Italy. Their occurrence at Toulouse suggests that they spread with the spread of the Visigothic kingdom, or rather perhaps the germs from which they developed. About 418 Honorius ceded the Gaulish provinces to them, and a little later six Visigothic kings reigned in Toulouse, the capital of Aquitaine, during the period of a century. Their kingdom stretched from the Loire to the Pyrenees, and from the ocean to the Mediterranean and the borders of Burgundy, while a great part of Spain was ruled by kings of the same race. The Court was cultivated to a considerable extent, and there was no lack of riches, as is proved by the spoil which Childebert took in 531, when he conquered Amalarik under the walls of Narbonne, his capital at the time. He took 60 chalices, 15 patens, and 20 Gospel

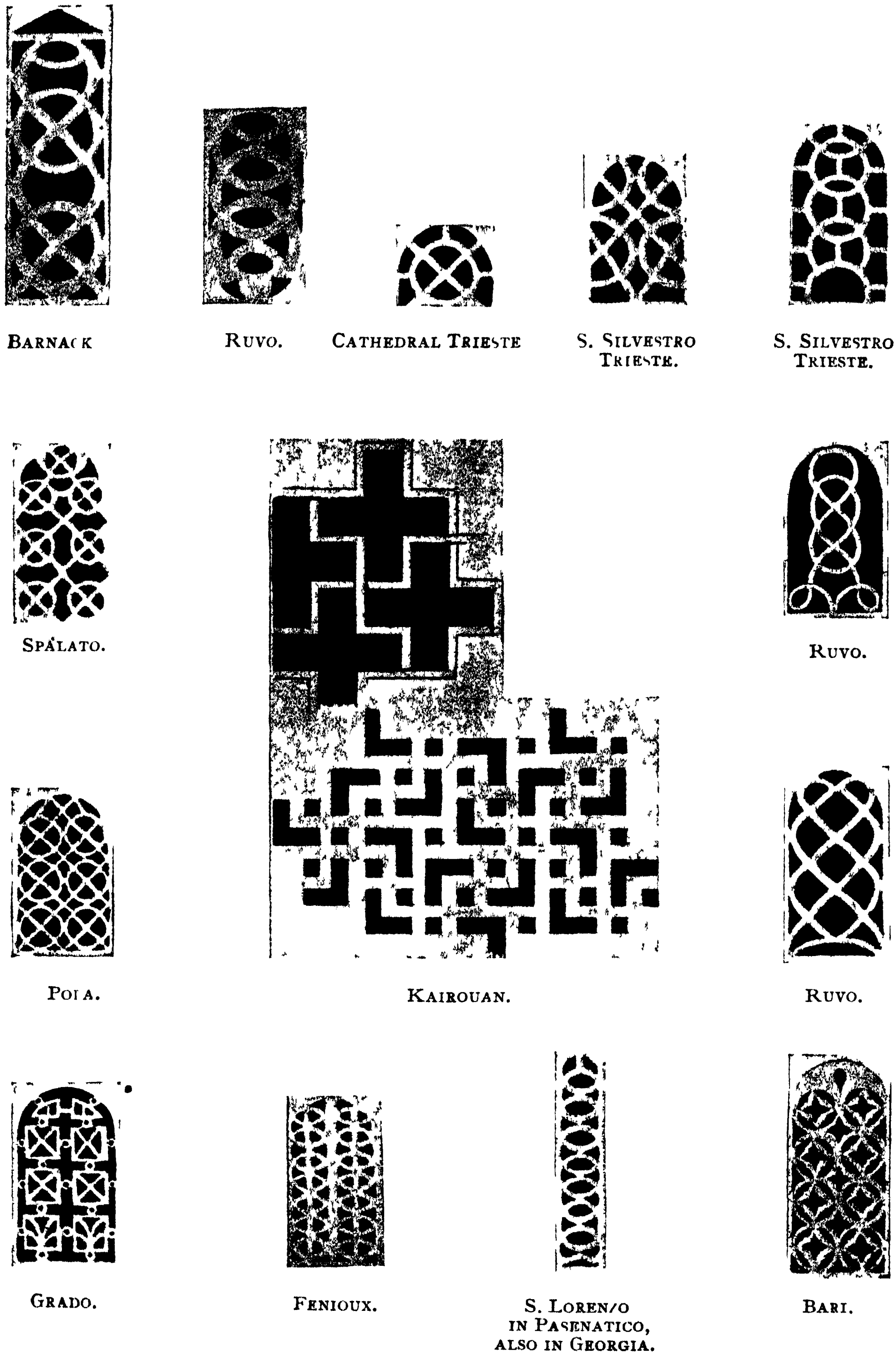
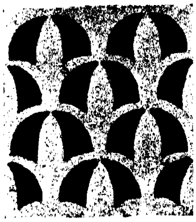
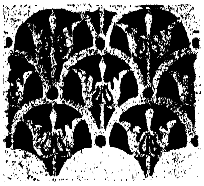


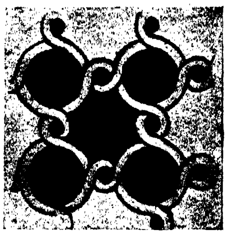
Fig. 28.—Pierced Panels from Various Places.



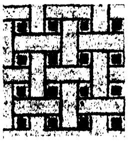
KAIROUAN.



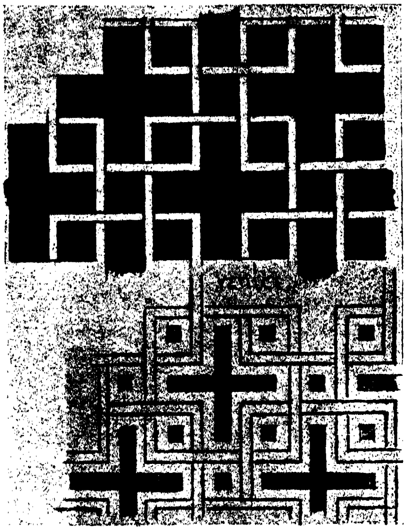
RAVELLO AND NOLA.



VENICE.

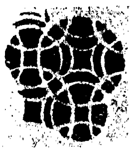


JERUSALEM.

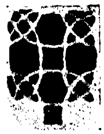


VENICE.

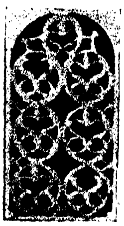
KAIROUAN.



S. MIGUEL DE LINO.



KAIROUAN.



S. SALVADOR
VAL DE DIOS.

CITTANOVA

KAIROUAN.

VENICE.

FIG. 28*a*.—PIERCED PANELS FROM VARIOUS PLACES.

cases, all of gold and precious stones, which he gave to various churches and basilicas. In Aquitaine the Goths were mixed with the Gallo-Romans in an appreciable quantity, as is shown by the place names, and the Merovingian cemeteries show an art with mixed influences, Syrian and Germanic.

There can be no doubt that the Lombards, as the Comacine masters were called after a time, most of them coming from that district, had great influence upon the development of architecture and ornamental art in the eleventh century. S. William, who was born at Novara in 961, according to one account, though another makes his birthplace the island of S. Giulio in the lake of Orta, was a disciple of S. Maieul at Cluny, and elected Abbot of S. Benigne, Dijon, in 990. He journeyed to Rome in 996, and brought back with him nine Italian monks "who were insructed in all arts, which they exercised and taught." In 1001 he began to build the new church, and the sub-structures attest evident connection between the Burgundian school and that of Lombardy, as do other Romanesque constructions in the country. He went on from Dijon to Normandy, to the abbey of Bernay, which he built, and then to Falaise, dying at Feçamp in 1031. Quicherat says that the lower part of the nave of La Madeleine, Vézélay, was built under his superintendence about 1010, and Jumièges and S. Bênoit-sur-Loire were under his influence at their commencement. Jumièges was contemporary with S. Miniato, Florence; it was roofed in the same way with alternate arches thrown across the nave, and roof principals, as was Cerisy-le-Forêt and S. Georges Boscherville.

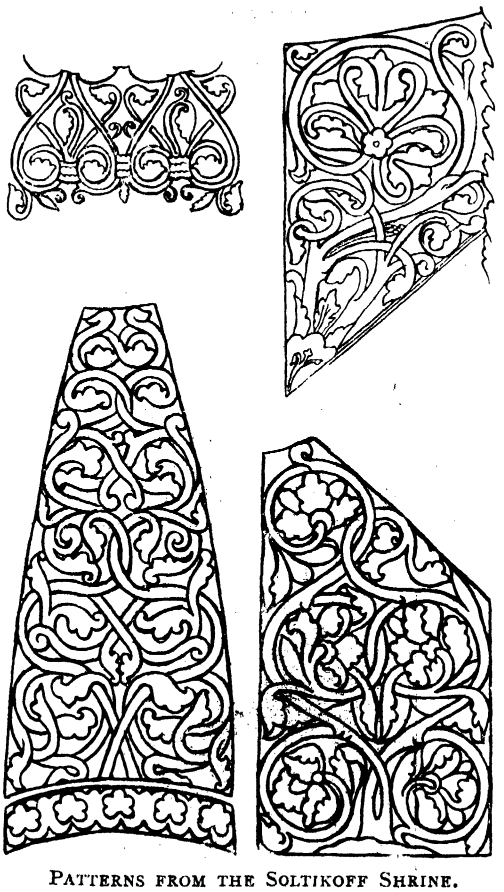
Lanfranc, who was one of the most illustrious and influential prelates in France and England, and one of the greatest builders at the beginning of the Romanesque period, was born at Pavia in 1005, was professor at Bologna before he came to Avranches to teach, and in 1042 became monk in the abbey of Bec, which he made so celebrated. In 1044 he was made Prior, and in 1077 consecrated the church. In 1050 he rebuilt the abbey of S. Evroult, and in 1063 was named Abbot of S. Etienne, Caen, which accounts for the plan upon which it is built. When Archbishop of Canterbury he built a cathedral, parts of which still remain, and founded the abbey of S. Alban's. His disciples spread his influence—S. Anselm, who was also an Italian, William, abbot of S. Etienne, Caen; Yves, Bishop of Chartres; Gondulf, Bishop of Rochester; and Pope Alexander II. There were also continual migrations of masons from north Italy.

At the churches of Nouvion-le-Vineux and Urcel, in the diocese of Soissons, of the eleventh and twelfth centuries, there are caps with lions facing each other, and the well-known Lombard two-tailed syren, closely resembling others at Sant' Ambrogio, Milan, and S. Michele, Pavia; and at Croissy, in Picardy, the twelfth century church has caps with a convention of palm leaves found on the much earlier ciborium at S. Giorgio, Valpolicella, and others which have the form, slightly modified, of leaves on little caps of the sixth century at Parenzo.

In Germany, too, the frequent use of small arcades upon the apses and other portions of churches, points to an Italian influence as well as the entasis, often exaggerated, of the colonnettes whether decorated with carving or plain as in the palace of Barbarossa at Gelnhausen. Charlemagne employed both Italians and Greeks for his church at Aachen, though the actual designer of the building appears to have been a German; in the middle of the sixth century Rufus, Bishop of Turin, sent to Niza, Bishop of Trèves, Italian artists for whom he had been asked, and at a later date also Italians were as certainly brought in as the Byzantines employed by Theophano. Otho III. made a certain Johannes, who is called by the chronicler the best artist in Italy, his painter in the cathedral at Aachen, and commended him to the care of Archbishop Notger, of Liège, and Archbishop Adalbert, of Bremen, had a painter named Trasmundus in his service in the second half of the eleventh century. After Otho I. took the imperial crown he was no longer a German prince; he had an Italian wife and for his son he obtained the daughter of a Byzantine emperor. There was a general enthusiasm for classical studies. Otho's brother, Bruno, Archbishop of Cologne, carried a library with him on his journeys. Hedwig, his niece, could speak Greek, and Gerberga, another relation, was a pupil of the nun Roswitha, who wrote spiritual dramas in imitation of Terence! These studies were not merely the fashion of the court: they were so well taught in the cloister that in the eleventh century the German monks were more learned than those of other continental countries. The revival of culture centred in Saxony and the Rhenish provinces. The royal families made them their favourite residences, and the presence of the court continually increased their population; there, too, were the richest monasteries and

abbeys. Under Otho II. studios were established at Trèves, the imperial residence, under the direction of Bishop Egbert (977-92) and S. Bernward, afterwards Bishop of Hildesheim (992-1022). A little later Siegburg is believed to have been the main centre for enamel work, with which the cloister workshops of Cologne, Verdun, Hildesheim, &c., were connected, though Von Falke thinks that pieces ascribed to its workshops were made elsewhere.

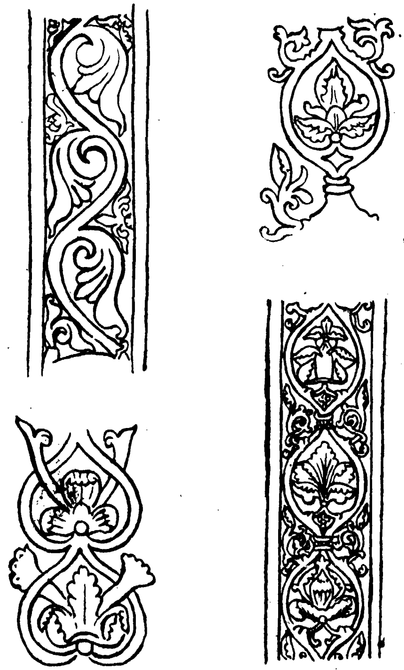
FIG. 29.



PATTERNS FROM THE SOLTIKOFF SHRINE.

At the end of the twelfth and beginning of the thirteenth century some extraordinarily fine metal work was done in France and Germany especially, but also in England, where the Gloucester candlestick, made for Abbot Peter between 1104 and 1113, on a smaller scale anticipates the beauties of the fine fragment at Reims and the splendid Trivulzi candelabrum in the cathedral of Milan. The magnificent shrines at Aachen, Cologne, Maestricht, and other places on the Rhine and Meuse indicate great wealth and remarkable talent among the goldsmiths of the end of the century. The craftsman monk who wrote the treatise "De diversarum artium Schedula," under the name of Theophilus, has been identified by Herr v. Falke as Frater Rogkerus, who was living and working at Helmershausen, about 1100. Several of his works are still extant, and show him to have been a clever goldsmith, who made no use of enamel, but preferred niello. His writings were based not only on his own experience, but upon receipts which he had obtained from Byzantine sources, and in the Lucca MS. also

FIG. 30.



PATTERNS FROM THE ESSEN CROSSES.

the Greek terms which are frequently mixed with the Latin phrases indicate that the technical details were for the most part a heritage from Greek sources. About this time the fine reliquary in the Victoria and Albert Museum, once in the Soltikoff collection, was made. It is the work of Frederick of S. Pantaleon, Cologne, who repeated the design on a slightly smaller scale with variations in pattern. This replica is at Vienna. He also probably made the reliquary at Darmstadt, one panel from which is also at Kensington, since the scrolls of the backgrounds are similar to those at Vienna, though not to those of the Soltikoff shrine (Fig. 29). The patterns upon the domical roof are very characteristic; I show

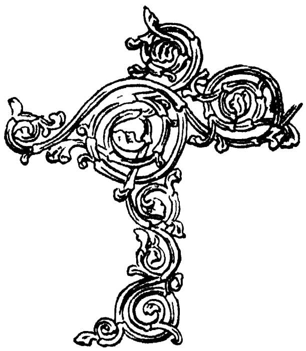
outlines of them traced from Didron's engravings. Abbot Suger of St. Denis (1152) employed several Lorraine artists for two years to make enamel pictures for the abbey. The earliest dated example of champlevé enamel is a cross at Essen (Fig. 30), upon which are the figures of the Abbess Matilda

FIG. 31.

PATTERNS FROM THE ESSEN CANDLESTICK AND TENTH CENTURY ENAMEL.

and Duke Otto, grandson of Otho I., brother of the abbess. He died in 982, so the work must be earlier than that date, but it is so superior in workmanship to another cross in the same treasury that it is suggested that it may be the work of Byzantines. There is another cross, given by Theophano, abbess 1029-54, with Oriental-looking enamels of

FIG. 32.



PATTERN FROM COVER OF GREEK TENTH CENTURY MS. AT SIENA.

birds, griffins, and lions. On the backs of these crosses the patterns are engraved which you have before you, showing characteristic Romanesque forms in a state of development. The Abbess Matilda also gave a fine seven-branched candlestick, of which there is a reproduction in the Victoria and Albert Museum. It was gilded and the knops decorated with crystals and precious stones. Here the Oriental influence is very marked, and the work round the lowest band again shows an approach to the forms of Romanesque while being also a good deal like the border of a tenth century Byzantine enamel (Fig. 31) now at St. Petersburg, both in the tendril-like leaves and the coil of lines. The detail from the cover of a tenth century Greek MS. at Siena (Fig. 32) shows the germs of the design of French ironwork

FIG. 33.

DETAILS FROM GREEK MS. OF NINTH CENTURY.

of the thirteenth century, and the involved curves only require to turn over with interlacing and overlapping a little to be very like those of the twelfth century MSS. written in Flanders. I ought to say, however, that M. Kondakov says that some of the enamels are of the eleventh and even of the twelfth century, but the tenth is the generally accepted period. Other details given from Greek MSS. of the ninth century (Fig. 33) which bear con-

FIG. 34.

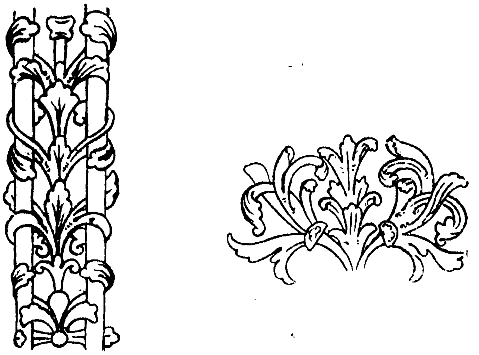
DETAILS FROM NINTH CENTURY CARVING, S. GIOVANNI, NAPLES.

siderable resemblance to portions of twelfth century patterns, can be parallelled by ornament in German champlevé enamels, as in a portable altar at Vienna, in which the flower on the right appears without change. A reliquary cross of the period of Nicephoros Phocas (963-69) preserved in the Franciscan convent at Cortona also has the scroll curves of the twelfth century arabesques fully de-

veloped, but the leaf forms are still rudimentary. Somewhat similar characteristics are found on a piece of carving in the church of S. Giovanni Maggiore, Naples (Fig. 34), which has pierced colonnettes with flowing patterns, and the ground covered with somewhat similar scrolls behind winged beasts. The germ of the twelfth century patterns appears here, with a very decided Oriental influence, which is also evident in some smaller scrolls, with animals in the intervals, which are on the back of a calendar of the ninth century in the same church. The treatment suggests bronze castings chased afterwards, and the details may very probably have been copied from some imported metal object. The derivation seems to be Persian, for some of the beasts are quite Assyrian in character, and the Sassanian carvings which have come down to us show a mixture of Assyrian and Greek influences. The extraordinarily beautiful ornament upon the base of the palace at Mashita, of which the Germans are now the fortunate possessors, is said to be Sassanian. It shows elaborate scrolls with beasts among them or facing each other over vases as in the well-known Byzantine subjects and a naturalistic feeling for detail which reminds one of the beautiful scrolls from the chair of Maximian at Ravenna, which I have shown you, and the ornament upon the great torus moulding suggests twelfth century French work at first sight. A less remarkable example is at Rabbath Amman, in which arcading occurs with zigzag and cable mouldings, with patterns beneath the arches like the Lombard carving of the ninth and tenth centuries, which is considered to be early Saracenic. A bordering strip has a kind of scale pattern of lines upon it which also appears on early mediæval sarcophagi at Trèves and in the south of France. In both these cases Hindu details and modes of work occur, but they are probably due to Syro-Greeks and imitate the design of textiles. Dr. Strzygowski concludes that Mashita is certainly the work of a Mesopotamian architect. If the opportunities for copying had been as great when these buildings were erected and ornamented as they are now, one would say it was needless to look further for the origin of Romanesque ornament. It is curious how long the type of foliage shown in the drawing from S. Giovanni Maggiore was in use. The elaborate scrolls upon the jambs of the west door of the Cathedral, Benevento, have the same kind of growth and much the same terminations, though it was carved in the twelfth century (1150-51), and the cathedral of Modena also has the same kind of scrolls decorating the jamb of the west door.

The revival of learning by Charlemagne brought Irish, Anglo-Saxon, and Carlovingian scribes in contact, and it is generally acknowledged that the term Franco-Saxon is properly descriptive of the MSS. executed in the north of France and the Low Countries in the ninth century, of which the Bibles of Charles the Bald are the best known examples, so that a similar influence from the English scriptoria might be expected in the next century. Now if we examine the MSS. executed at New-minster and isolate the details, we shall find several which are familiar to us at a much

Fig. 35.

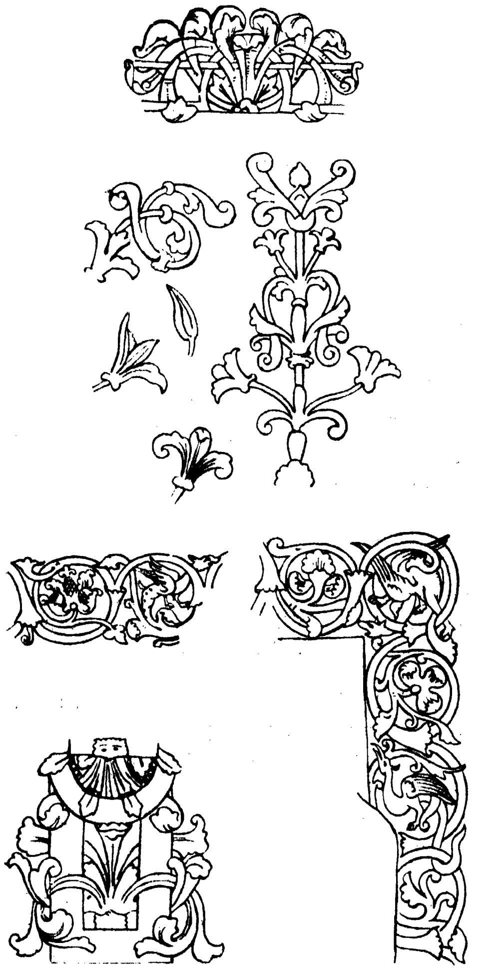


Ornament from Winchester Charter and Tenth Century MS.

later period. This, for instance, I am sure, would not much surprise you in the border of a thirteenth century window, but it is from the charter of 966 (Fig. 35), and these details of a somewhat later date may be paralleled by foliage both carved and wrought in iron many years after on the continent (Fig. 36). The New Minster at Winchester was founded by Alfred and put under the rule of the learned Grimbald for the purpose of educating the sons of the nobles. Grimbald had been in the monastery of S. Bertin in Artois and entertained Alfred there when on a journey to Rome in his youth. In 884 or 885 the King sent an embassy to Fulke, Archbishop of Reims, and the Abbot of S. Bertin, entreating their sanction to his coming. They presented a gift of wolfhounds. Fulke said that he sent in return a spiritual watch-dog to guard the Christian flock. Alfred assigned an eighth of the revenues of his kingdom to its support, and told his nobles either to study or resign

their offices. He said his desire was "to provide houses for study, workshops for the writing and adorning of beautiful MSS., peaceful patterns of civic life, well-ordered communities resonant of labour and praise." A great school of illuminators was developed in the abbey, which produced some of the finest

FIG. 36.



ORNAMENTS FROM ENGLISH MS. OF ELEVENTH CENTURY.

MSS. of the period in existence, among which may be mentioned the Benedictional of S. Ethelwold, written by Godemann, who became abbot of Thorney about 970, and the MS. in the library at Rouen, which is so much like it, and was probably written for the first Benedictine abbot of Glastonbury, Ethelgar (965), who was made Bishop of Selsey in 978 by Dunstan, and succeeded him as Archbishop of Canterbury in 988. Robert the Norman was made Archbishop of Canterbury by Edward the Confessor, but was obliged to fly before the English indignation, and carried this Benedictional with him. In the register of Hyde Abbey (as Newminster was called when it was removed outside the walls) is a fragment of exultet with the musical scale in use

FIG. 37.

B. FROM WINCHESTER TENTH CENTURY MS.

before Guido, of Arezzo, invented the present gamut in 1020. It contains the names of several illuminators, Ælsinus, Æthericus, Wulfricus, all Saxons. It was written for Ælfwine, who was then monk and deacon.

FIG. 38.

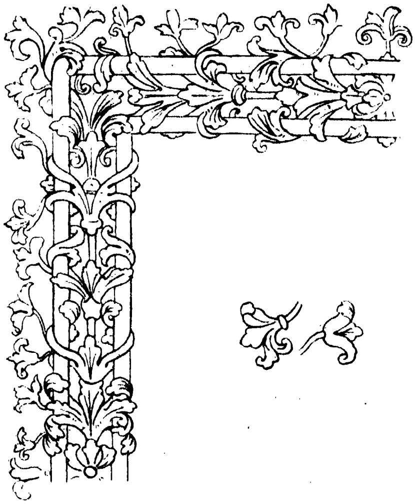
ORNAMENT FROM SAME MS.

He became abbot in 1035. This fine B (Fig. 37) is from a psalter written in 963. It served as a copy for other MSS. written at a later date. The scroll work (Fig. 38) is from the insides of other initials of the same MS., and shows how near the design had come to the fine German twelfth century initials. This is

another piece of the border of the charter of 966 (Fig. 39), and shows the development of details from the earlier Saxon MSS.

In later Saxon times intercourse between England and Germany was close and frequent. As early as the end of the eight century an Englishman named Lul was established at Mainz to whom S. Cuthbert, Abbot of Jarrow, wrote asking him to send experts in glass-making. Carolingian culture had two principal centres, Tours and Aachen. Alcuin, of York, planted in the school of Tours his own Northumbrian learning and had pupils from

FIG. 39.



BORDER OF CHARTER OF 966.

nearly all the centres whence the first feeble struggles of mediæval art proceeded. Dr. Smith says in his dictionary of Christian biography, "Among the scholars in the palatine school were Charles himself with his sons Charles, Pipin and Lewis, his sister Gisela and his daughter of the same name; Angilbert, afterwards Abbot of S. Riquier; Adalhard, Abbot of Corvey; Rigbod, Archbishop of Trèves; Rictrudis, a noble nun of Chelles; and Gundrada, sister to Adalhard. His most famous pupils during his later years at Tours were Rabanus Maurus, afterwards Archbishop of Mainz; Hatto, Abbot of Fulda; Haimo, Bishop of Halberstadt; Samuel, Abbot of Lorsch and afterwards Bishop of Worms; Adalbert, Abbot of Ferrières; Aldric, Bishop of Sens; and Amalanus, deacon of Metz." From the sixth to the eighth century missionaries went from Britain to Frisia, Germany, Switzerland, and even to Italy. The same ornamental motifs are found in Ireland and in Switzerland, where Latin culture was preserved.

In the treasury of the principal church of Maeseyck a MS. of the Gospels is preserved which dates from the eighth century, and has illuminations quite Anglo-Saxon in character, together with fragments of embroideries, similar in design, which were found in a shrine. They are the work of two nuns, sisters, named Erlinde and Relinde, painters and embroiderers, according to tradition, who learnt their craft from Anglo-Saxon missionaries. As late as 1183 Anglo-Saxon design exercised a certain amount of influence. The church of Petit Quévilly, near Rouen, has painted decoration, said by M. Gonse to be of a rich, severe, and delicate style of a curiously Anglo-Saxon character. S. Columba founded monasteries at Fontaine, Anagratum, and Luxeuil, at the end of the sixth century, and then Bobbio in Italy in 613. He also lived near Bregenz. S. Gall, the apostle of Switzerland, whose Irish name was Cellach, went thither, at the beginning of the seventh century, and founded his monastery in 614. S. Cataldo (Cathal), patron saint of Taranto, was a pilgrim Scot from Lismore, in the seventh century. S. Donnat (Donncadh), his brother, was Bishop of Lupice, in Naples. St. Kilian, apostle and martyr of Franconia (689), is commemorated at Würzburg, where the MS. of the Gospels found in his tomb is annually exposed on the altar. At the monastery of Honangia, founded on an island in the Rhine near Strasburg, by Tuban, an Irish bishop, a charter of 810 is preserved which recites grants to the monastery, the poor, and pilgrim Scots. Nine Scots are named in it, eight of them bishops. There was a convent of Scots at Mount S. Victor, near Feldkirch, in the ninth century, and Dungal the Scot, author of the letter to Charlemagne on the eclipses of 810, became preceptor of the cathedral school at Pavia. Willibrord and Boniface, who came from Crediton, sought the conversion of Frisia and of central Germany in the first half of the eighth century, and they were accompanied and followed by a large number of Anglo-Saxon fellow workers, SS. Lievin, Wilfred, Wigbert, Suitbert, Ewald, Willibald, nephew of Boniface, Wynnebald, &c. Willibrord founded Echternach before 739, and Suitbert founded Kaiserswerth. Fergal or Virgilius, an Irishman, was Bishop of Salzburg in the eighth century. The relics of British saints are revered in other Continental places which commemorate their names, as S. Gobain near Laon, where the

relics of S. Gobhan are enshrined above the high altar. In 856 Ethelwulf married Judith, daughter of Charles the Bald ; Ogive, daughter of Edward the Elder, married Charles the Simple; Hedwig, Hugues the great Count of Paris ; Edgiva, Louis the blind Count of Provence ; Adela, Ebles Count of Poitiers Another granddaughter of Alfred wedded Otho the Great of Saxony. At a later period the emperor was married to Chunelinde, daughter of Cnut, the Athelings, Edmund and Edward, had married nieces of the emperor, and German clerks were at the head of the Wessex church —so the channels for reciprocal artistic influence were open between the countries, and continued so, for in 1114 Henry V. of Germany married Matilda, daughter of Henry I. of England, who after his death in 1125, married Geoffrey Plantagenent, Count of Anjou, in 1129. (Figs. 40 and 41). But the plan lines are nearly the same as those from a vase in the Esquiline treasure, which we have seen repeated upon the Anglian crosses at Nunnykirk, Lancaster, and Kendal, and similar curves form the bases of many of the late Roman mosaics of ornament both on vault and floor. In these panels from Torcello we have a modification of the same kind of curves, with foliage flowers in the centre and with animal forms introduced (as they are also in the Esquiline treasure) and animal forms playing through the scrolls are one of the characteristic details of Romanesque ornament. The heart-form as basis for ornament, so frequently used in German Romanesque especially, as in this late example from Gelnhausen, is Oriental, and the strap-like processes which enwrap it are seen in early Saxon MS., while the flower in the centre

FIG. 40.

ORNAMENTS FROM CATHEDRAL, VERONA.

In every pattern there are two portions, the underlying curves or geometrical planning, and the details which disguise or emphasise the basis according to the fancy of the designer. Now the schemes of curvature of most of the Romanesque scrolls are simple, and common to both later classical and Byzantine ornament. In this ivory vase from the British Museum, for instance, which is probably of Syrian manufacture, the curves might be of any period from the sixth century to the tenth, while the birds in the borders suggest Coptic influence, and the antique frets have developed into the riband pattern which we have seen at Moissac and Avalon. The heads in circles seem to be an earlier form of a detail frequent in Byzantine work of the tenth or eleventh cenury. Take next this strip of ornament from the Cathedral, Verona, and compare it with this gold bracelet in the Franks Collection at the British Museum, said to be Egypto-Byzantine work, and the virtual identity of line and subject is apparent. is based upon Byzantine details. The elaborate interlacings of curves in the splendid initials of the German MSS. of the twelfth century are only developements of the same features used at Winchester and elsewhere long before.

FIG. 41.

ORNAMENT FROM BYZANTINE BRACELET FROM EGYPT, BRITISH MUSEUM.

In the Victoria and Albert Museum is a curious little carved oval box which is said to be Byzantine work of the ninth century. If this ascription is correct, about which I have my doubts, though I cannot speak as an expert upon the matter, it is a very curious example of the early evolution of an ornamental form which is of frequent occurrence in the twelfth

century. I mean the scroll flowers on the lid which only require a slight scalloping at the edges to become quite like ornaments which are common in the MSS. of that period illuminated in Flanders and North West Germany.

We have seen that the Comacines or Lombards had a great deal to do with spreading certain patterns round the basin of the Mediterranean, and that Lombards at a later date were the prime movers in the development of the architectural style termed Romanesque. Most of these masters were ecclesiastics of one kind or another, or at least worked under the shelter of the church in which they had taken some kind of vows. The cloister was the only secure refuge for those who were not prepared to make fighting their principal business, and men of refinement who were peaceably disposed naturally gravitated to it. Here men of various nationalities met and could discuss problems which had arisen in following their various pursuits, for all those instructed at all spoke Latin, and learning progressed. Here was the great scriptorium where valuable books were written and illuminated; here were the workshops, in which work in all kinds of materials was carried on; here were the masons, the designers, the carvers, enamellers, goldsmiths, mosaic-workers, painters, writers, joiners, and so forth—a busy hive of constant employment. The country was made to blossom and bear fruit, architectural and engineering works were carried out, and protection was afforded to all the vassals. The great Benedictine monastery, in fact, was the centre of all kinds of mental activity. Take the history of S. Bernward as an instance of the life of such a master. He was born about 960, of a noble Saxon family, and brought by his maternal uncle, Deacon Folkmar, later Bishop of Utrecht, to the Hildesheim cathedral school, which was under the direction of Thangmar, schoolman, notary, librarian, and dean at a later period. At that time the bishop's court of Hildesheim was the centre of culture of Eastphalia, embracing great variety of pursuit and also the practical use of mechanical arts. His biographer mentions that Bernward practised artistic writing, painting, working of metals, setting precious stones, and architecture. Cloister workshops, schools, and warehouses lay upon and around the cathedral hill. He was ordained exorcist, and afterwards priest. He then went to his maternal grandfather, the Pfalzgraf Athalbero, and managed his affairs till he died in 987. He was then summoned to Court, and made tutor to the youthful Otho III. by the Empress Theophano. After her death he was made Bishop of Hildesheim, and consecrated in 993. Thangmar gives us details of his daily occupations. Not only in Hildesheim, but in other places in the diocese he founded scriptoria for the production of liturgical, philosophical, and theological literature. In the workshops painting and sculpture, goldsmith's work, mosaic, and the laying of tiles by a process of his own were carried on. Talented youths accompanied him on his journeys to make drawings of notable things which he had not time to record himself and to study. He planned the church of S. Michael Hildesheim, and most of it was carried out under his superintendence, though the fire of 1186 destroyed a good deal of his work. He made several crosses ornamented with filigree and pearls and with large crystals on the arms, a silver crucifix with the body arranged to hold relics, two gospel book-bindings and a paten with engraved panels of the cardinal virtues. Several MSS. in the treasury were written for him. In the Magdalen church are two candlesticks of an alloy of silver and copper, formerly gilded. His celebrated doors were made for S. Michaels in 1015. He also made a column of bronze 14 feet high with reliefs from the life of Christ in the manner of the Trajan column; and his graveslab and sarcophagus, both of which Thangmar notes as being his own work. Another example is Bishop Benno, of Osnabruck, who practised nearly as many different arts as S. Bernward. He first appears as a pupil, but soon acts as master builder at Hildesheim, then goes to Hungary with a host on account of a famine, finishes the building of castles left incomplete by Henry IV., then acts as viceroy for Archbishop Anno in the principality of Cologne. After he became Bishop of Osnabruck he drained the marshes, and became so celebrated as an hydraulic engineer, that the Emperor called him to Speyer to make the cathedral secure from floods of the Rhine. At a later period he often accompanied him on his journeys (carrying on his building operations by correspondence), and had artists with him to make drawings. Norbert, abbot of Iburg (1118), his biographer, says that when he was building the monastery of Limburg, the cathedral of Speyer, which was finished in 1060, and the collegiate church of S. Guido in the same city, he established a school of architecture

there under the protection of the emperors, and that pupils came from all parts of the empire to give themselves with ardour to the study of architecture.

The activity of these great men is astounding. They combined the practice of the architect, the founder, sculptor, painter, scribe, goldsmith, and even the organ builder, and were also teachers, theologians, and sometimes physicians, statesmen, and jurists. In England also ecclesiastics were often capable craftsmen. Leaving out S. Dunstan as being well-known — "who understood masonry, carpentry, and smith's work; could draw, paint, and design; was a musician, composer, and maker of musical instruments," as well as a distinguished ecclesiastic; let us take Anketil, of S. Albans, who was brought up as a goldsmith, and had passed seven years in Denmark making things for the king and superintending the royal mint. Returning to England, he became a professed brother of S. Alban's, and made the great feretrum, shrines for the relics of SS. Bartholomew, Ignatius, Laurence, and Nigasius, elaborate candlesticks, censers, and incense boats. The shrine of S. Thomas, of Canterbury, was the work of "that incomparable official," Walter of Colchester, sacrist of St. Albans, who was assisted by Elias of Dereham, Canon of Salisbury. Three smiths "expert at shaping" are mentioned by name among the monastic brethren of S. Patrick, and three skilful artificers. A bishop named Coula was S. Bridget's principal artist in gold, silver and other metals. When the same man worked in metal and illuminated MSS it was natural for the patterns to be sometimes counterchanged, and this may perhaps explain the genesis of the involved patterns known as Celtic, which Mr. Romilly Allen says must have been copied by Christian artists from the designs invented by Pagan enamellers upon late Celtic bronze bowls. Since all the bowls of this class have been found in England it is there that the spiral work of the MSS. must have originated and not in Ireland. If this theory is correct it will explain the perfection of design and the certainty of hand in the earliest certainly dated MS. with zoomorphic patterns, the Lindisfarne Gospels—in which the elaborate interlacing patterns appear to be derived from metal work. S. Dageus, who lived in the sixth century, and made many shrines, was also an illuminator. S. Éloi made shrines of gold and silver to many saints, which his biographer enumerates, and was Master of the Mint to three French kings. The annalists of the ninth and tenth centuries mention a number of works of art, including metal work for altars, made by monks. Folcuin, in his life of Notger, Bishop of Liège (971-1008) describes a wonderful Gospel ambo which he had made. "It was composed of a hollow formed of four half-cylinders set crosswise. The four faces of bronze, worked with the hammer, were, according to the fancy of the artist, covered with chisellings and with gilding, and held together by silvered uprights. On the north side the ambo had a reading-desk in the form of a cast eagle magnificently gilded, which raised its wings or extended them to receive the gospel book. The neck moved by means of an ingenious mechanism—the bird appeared, in some way, to listen to the deacon's chant, breathing forth at the same time clouds of perfumes produced by incense thrown upon lighted braziers hidden inside the body." Villars de Honcourt draws such an eagle, and at Mainz there were two cranes which behaved in a similar manner. These mechanical pieces of furniture were probably suggested by the report of the magnificence of the throne called "Solomon's" in the imperial palace at Constantinople; which was of gold enriched with precious gems with mechanical birds which sang perched upon it: "above shone an immense cross encrusted with precious stones; around were golden seats for the imperial family. On the steps were two lions of gold, which rose to their feet, roaring. Thereby were golden trees, on the branches of which birds of different kinds imitated the songs of those in the wild wood."

With craftsmen of such capacity within the monasteries—with men of such varied powers directing affairs—with the contact and friendly competition of the qualities of many nationalities, Eastern and Occidental, meeting in the truly cosmopolitan cloister: and with varied and suggestive material brought to the door by commerce, either the spoil of ancient civilisations or the traditional products of the unchanging East, was formed a cradle in which the young Romanesque art was fostered, and from which it soon leapt forth in strength and splendour to pleasure the West with its beauty.

I have now shown you what Romanesque ornament is, and I hope justified the strong expressions of appreciation of which I made use in the opening lecture. I have demonstrated that it is principally based upon Byzantine design, which itself was based

upon Persian and Syrian ornament, and have given instances in which the direct influence of Oriental models may be assumed; I have traced various modes in which these influences probably penetrated the various countries of the West, and how they were modified by local and national peculiarities, among which I have shown that the English may have borne great part; and, finally, that the principal portion of the welding together of the various elements of which the style is composed took place in the cloisters, where art work of many kinds was carried on side by side, each craftsman influencing his neighbour whether working at the same or at a different craft. And it now only remains for me to express my thanks, firstly to you for the patience with which you have borne with my transgressions of the hour limit, which appears to be considered the measure of the endurance of an English audience; then to the authorities at South Kensington for their kindness in preparing slides of 15 subjects from the Museum; and, finally, to my friend Mr. Ashton, whose admirable management of the lantern has allowed you to see the fine collection of slides made from his excellent negatives to the best possible advantage.

INTERNATIONAL CONGRESS OF SCHOOL HYGIENE.

The President and Hon. Secretaries of the Second International Congress on School Hygiene have communicated the following account of the arrangements for a new permanent council which were resolved upon at the closing meeting of the Congress:—

The permanent International Committee, consisting of about sixty members, selected from almost every country, has hitherto only met during congresses. Arising out of the question of whether it would not be a proper thing to establish a bureau, with a permanent staff, library, and museum, and so on, in some central but neutral spot, such as a Swiss or Dutch town, it was decided, as explained by Drs. Mathieu, Burgerstein, and Kerr, that it would probably lead to greater progress if such bureau was not localised, but if each country had its own centre for the diffusion of knowledge, and to act as a clearing-house in the matter of school hygiene statistics, laws, and regulations. Finally, to supervise in scientific matters, and generally to do all that is possible at all times or places to forward the human interests which are bound up in the special lines of knowledge included in school hygiene, the International Committee has formed a small council.

This Council has all the powers of an ordinary committee. It can form sub-committees of experts on special enquiries. The usual committee procedure is to sit round a table and discuss matters, but this Council will deal with the various subjects that arise, submitting the different topics by correspondence, collating the answers, and, finally, making pronouncements in urgent matters after a meeting of the Council.

It is obvious that for efficiency such Council should be small and yet have in it elements to secure permanence, and, at the same time, possibilities of slow but constant change. This has been done by deciding that it shall consist of the president of the past Congress, the president of the Congress which has just been held, and the president of the next Congress. Nine other members are to be elected, of whom three are to be from the country where the Congress was last held, and three from the country where it will be held next, three being selected from other lands.

Certain matters, for instance, will almost at once come under the consideration of this Council. Such might be quoted as:—

"The question of how medical inspection of schools can best be carried out with the maximum of efficiency and minimum of cost.

"The question of how far the laws of health can best be imparted to the coming generation so that later they will know how to care for themselves and those dependent on them.

"The best systems or methods of physical training for both sexes at various ages.

"The feeding of children requiring proper nutrition so that it shall be done without developing pauperism, and with regard to those upon whom the cost falls."

These four matters are being dealt with practically in a great variety of ways, and this Council should be able to collect and analyse known facts to show which methods are best for any town or State.

It is obvious that information thus digested will have a very great value politically as well as educationally, and this Council may in time come to be officially regarded as quite analogous in matters of school hygiene to that other Congress of Peace now in session at the Hague.

RISE AND TENDENCIES OF GERMAN TRANSATLANTIC ENTERPRISE.*

There was no German traffic beyond the seas to speak of before the formation of the United States. The consequent disruption of the Colonial system produced lively trade-relations during the ensuing period of French revolutionary wars. After a short interruption, produced by the "continental system" a second impetus was given by the establishment of other independent States in South and Central

* Abstract of paper read by Professor Ernst von Halle, Ph.D., before Section F of the meeting of the British Association, at Leicester.

America, 1815-1830. The abolition of the Colonial system in the rest of the European colonies marks the third phase of expansion, and the opening of trade relations with Eastern Asia; commercial treaties with Japan and China the fourth. Preceding the formation of the German Empire there existed a very limited commerce with Africa. By 1871 German tradesmen and bankers, particularly sons of the Hanseatic towns, were to be found in all parts of the world.

A few German merchant princes, and a larger number of small tradesmen abroad, not only maintained relations with their country, but also handled the traffic of other commercial nations.

London was the money market, and to some extent the money lender. On the other hand, a large share of German Transatlantic exports and imports passed through English warehouses, and more still in English bottoms. The political decentralisation of the country had for centuries left the majority of German States without seaports and seafaring interests. The Zollverein brought commercial unity to the interior and Baltic sections, but did not embrace the North Sea ports till after the three wars which gave the Empire a flag and a commercial policy.

At this time the population, which had doubled since 1800, numbered 42,000,000. In the next thirty years 20,000,000 more were added; 65,000,000 live to-day where about 20,000,000 lived at the close of the Napoleonic wars. Besides the increasing population, three events—the opening of the grain fields in North America, the introduction of iron and steel steamers into the Transatlantic freight service, and the rise of large industries in Germany after the war—were the chief cause of the country's transition from a grain-exporting nation into a grain-importing nation by the middle of the seventies. The industrial crisis increased the protectionist tendencies among the manufacturers, while American competition turned the agriculturists to protectionism. But the new economic policy did not stand in the way of rapidly increasing imports, which had to be paid for by increasing exports.

It was not the manufacturing interests that nourished exports, but rather the demand of a growing population for food-supplies and industrial opportunities of employment. Up to this time Transatlantic enterprise had been of a somewhat incidental significance for German national economic life: it now became vital. Larger exports of merchandise and capital for foreign investment, the establishment of large commercial fleets, insurance and cable companies, now became necessary to meet the increasing requirements of the importing interests. By inaugurating a Colonial policy in 1884 Bismarck meant to crown the process of empire-making.

The censuses of 1882 and 1895 show a remarkable transformation in the economic structure of Germany. Unable to employ a larger number of people in its pursuits, agriculture had thrown the full surplus population into industrial occupations. The agricultural classes in 1815 numbered about 18,000,000 about the same as a hundred years ago, whilst the industrial population had increased 600 per cent. The standard of life had improved throughout, chiefly in the middle and lower classes; but in spite of the introduction of scientific methods, agriculture was unable to keep pace with requirements.

By 1900, one-fifth to one-fourth of the foodstuffs, and more than nine-tenths of the raw material for clothing had to be imported. Had not a rapid development of foreign trade and rising foreign investments closely followed the resulting neccessities, either starvation, or emigration, or foreign war would have resulted.

To avoid a precipitated industrialisation and a dangerous decline of agriculture, the country decided upon an increase of agricultural protection. Germany's geographical position will always necessitate an ample agricultural resource at home to avoid the dangers of starvation in war times. It was compelled to sacrifice some of the industrial possibilities of tariff-treaties to this point of view.

The situation to-day is that Germany's foreign commerce amounts to £750,000,000, of which £425,000.000 are imports.

Of the difference, fifteen to twenty millions are made up in the earnings of German shipping, the rest in the interest from foreign investment, consisting of £450,000,000 investments in trans-oceanic countries, £800,000,000 foreign stocks and bonds (of which more than £100,000,000 is trans-oceanic), and more than £250,000,000 other investments.

Of the imports, about 40 per cent. come from over the sea outside of Europe, while of the exports a little less than 25 per cent. go to foreign continents, more than 30 per cent. of its trade.

With neighbouring countries Germany exchanges more than 40 per cent.

The trade with the United Kingdom amount to about 20 per cent. of exportation and 14 per cent. of the importation, and with the British Empire 24 per cent. of exportation and 22 per cent. of importation. While England has ceased to be paramount in German Transatlantic trade, it still holds the first rank. Of the commerce of the world, incoming and outgoing, the three leading countries—England, Germany, and the United States—to-day control not less than 40 per cent. in either direction. Of this, a large share is transacted among these three countries.

German exports have not increased as rapidly as the demand for imports. The foreign investments are rising in importance. They may become the leading feature by the time that machine-using industries have become more extended in tropical and sub-tropical countries. Germany will have to improve its commercial and industrial processes, its means of transportation, and its business organisation to keep pace with foreign competition. The real dangers of the competition of the future are neither to be found in England nor in Germany, nor even in the United

States, though this latter country makes a more rapid progress than the two former. They will ensue from the working of certain natural laws: increasing populations, increasing demand for the products subject to diminishing returns, and increasing supplies of the products subject to increasing returns.

The political tasks of Germany's future are continental, in consequence of its central position, but her economic tasks will necessarily consist of an extension of every form of her commercial sea-interests.

THE MOTOR CAR TRADE IN THE FAR EAST.

In Singapore, the Federated Malay States, and in the islands of Sumatra, Java and Borneo, the motor-car trade is yet in its infancy. In Singapore there are at present about sixty passenger cars, and some fifteen to twenty goods-carrying lorries. In the city of Singapore the cars are all owned by doctors, professional men, and some motor enthusiasts, and the interest in motors is said to be growing daily. According to the American Consul-General, the field being practically uncanvassed for many years, it has not been thoroughly gone over, nor have the majority of the right people been approached for the sale of motor-cars. The roads are excellent, being entirely macadamized, and are constantly cared for by the Government; in some portions of the city the gradients run from 20 to 30, and in no instance are the roads less than sixty feet wide. To obtain a license to drive a motor-car or a motor-cycle, one must apply and pass an examination before the chief of police, and if in his estimation, the candidate is capable of handling a car the license is granted on payment of a fee of about two shillings and fourpence. Apart from Singapore the demand for motor-cars is growing extensively in the Federated Malay States, and in Sumatra and other islands in the vicinity. The Chinese and natives take to motoring very easily, their chief interest being centered in the decorations and colour of the body of the car rather than in the ability or workmanship of the engine. Of course it is needless to comment upon the tastes of Europeans, there being a sort of national pride on the part of the English and French to drive nothing but their own manufactured cars. The greatest difficulty is the constant heat, as this causes tyre troubles, and while the majority of cars are equipped with pneumatic tyres they are now putting on clincher tyres, taking the risk of injury to the engine and car in preference to the constant purchasing of new tyres. The favourite car is a four-seated ten to twelve horse-power double cylinder, and although there is no speed limit, there is not nearly so much reckless driving as one sees at home. Gasoline can be had in any quantity and fairly cheap, as there is any amount brought from the island of Sumatra. The cars in use, with the exception of one or two, have no magnets, but rely entirely upon accumulators and coils for the spark. An enterprising manufacturer could, it is said, do an excellent business if he entered the field and his prices were moderate, as battery troubles are common. Lubricating oils are all very good and very little trouble occurs through this source. The air-cooled motor is not a success, the weather being much too warm; the radiators upon the water-cooled machines will sometimes remain hot for days at a time. The conditions in the islands of Sumatra, Java, British North Borneo, and also the Federated Malay States, are practically the same as in Singapore Owing to the absence of railway accommodation, and in most parts there being no railways at all, the Government has spent a great deal of money in making excellent roads, and the rich natives are ready for the purchase of motor-cars.

ANGORA MOHAIR.

The mohair of Asia Minor is known and prized the world over for its soft and silky texture. The best qualities come from the provinces of Angora, Kastamuni, and Konia. The number of goats in Asia Minor, from Smyrna to the Persian borders, and from Arabia to the Black Sea, is roughly estimated at 3,000,000. No exact statistics are to be obtained as to the quantity exported last year, but the value is generally estimated at £750,000. With the exception of small quantities brought to Smyrna, the mohair which finds its way abroad is usually sent to Constantinople, and thence, through the medium of English merchants and English ships, to England. English merchants have always, more or less, been able to keep a firm hand on the mohair market. In so doing they have been able to inflict damage on the industry in Turkey, for, in spite of all the efforts of the Turkish Government to prevent it, the Angora goat was smuggled out of the country and successfully reared on the veldts of Cape Colony and Natal. In spite of the application of the most severe prohibitive measures, the Turkish authorities were powerless to do anything in the face of such exorbitant prices as were paid to the peasants for their flocks. According to the American Consul at Smyrna, more serious attention is now being paid to improved methods of rearing the Angora goat in Asia Minor. The Turkish Government has been giving assistance of late in establishing model stations for the improvement of the breed on a scientific and rational basis, as it is claimed that Angora wool, in softness, length, and durability is superior to that produced in South Africa. There is a movement on foot at present in Asia Minor to start factories in the wool-growing districts, in order that the old primitive methods of utilisation may be superseded. This will be done with a twofold object in view, namely, the creation of a means of employment for the people of those districts, and an outlet for the product at home, which will render the industry, on the whole, less dependent upon the foreign demand.

HOME INDUSTRIES.

A Co-operative Mill.—A new and interesting venture in co-operative production is now being set on foot at Hebden Bridge, in Lancashire. It appears that about a year ago the fustian weavers of that place had a dispute with their employers about wages, and went out on strike. Some 500 hands were affected, and most of them are still out of employment. There being no likelihood of settlement, it was suggested by some friends of the strikers that they should go in for joint work and joint factory ownership. The co-operative principle seems to thrive at Hebden Bridge—the Hebden Bridge Fustian Manufacturing Society of that place was one of the pioneers of the movement. A scheme was formulated, and already over 2,500 £1 shares have been taken up. A site of 48 acres has been secured, 17 of which is farmland, and the rest woodland. It includes two factories of six stories each, one a turbine factory, and the other possessing a new engine and boiler, besides several cottages. The purchase price is £3,750, and it is claimed that the rents, leaving the steam factory free, would pay 2⅝ per cent. on the outlay. The model rules of the Co-operative Union, says the *Manchester Guardian*, to whom the writer is indebted for these particulars, with special rules to meet the requirements of the society, have been sent up for registration, and it is expected that the society will be at work shortly. The site, it is said, lends itself to the making of a co-operative garden village, and the experiment will be watched with interest. The manufacture proposed will be new to the neighbourhood, and many promises of provincial support have been obtained.

The Consumption of Cheese.—It is not surprising that the manufacture of cheese is declining in this country, for there is an ever-increasing demand for milk. The average consumption per head of milk in the United Kingdom is officially estimated at 15 gallons—this is the figure arrived at as the result of two separate inquiries made for the Royal Statistical Society in 1892 and 1904 respectively, and it is adopted by the Board of Agriculture in their report just issued. It follows, since there are practically no imports of fresh milk, that the demand which British farmers have to meet is now increasing at the rate of some 6,000,000 gallons annually. It is reckoned that during the past twenty years the annual consumption of milk has increased by something like 100,000,000 gallons. This accounts for the contraction in British cheese making, for the increase in the number of milking cows, and the improved methods of management which have done something to raise the average yield per cow, are not more than sufficient to meet the growing demand for milk. It is noticeable that for the past ten years the imports of cheese have shown little tendency to increase. It is true that the total imported in 1906 was larger than in either of the two years immediately preceding—2,638,794 cwts., as against 2,442,682 cwts. in 1905, and 2,554,297 cwts. in 1904—but it was less than in 1903, when the imports amounted to 2,694,358 cwt. And if the proportional quantities of cheese per head of the population imported in 1900 and 1906 are taken, it will be found that, whilst in 1900 they were 7·4, in 1906 they were only 6·8. The conclusion, therefore, seems unavoidable that the people of the United Kingdom eat less cheese than they used to do; on the other hand, much more meat is consumed. It may be mentioned that of the total imports of cheese Canada sends no less than 73 per cent.

Dispensing Chemists.—It may be gathered from the report of the Medical Officer of Health of the City of London that a good many dispensing chemists are less careful as to the amount of water they put with their drugs than is desirable. Seven prescriptions were examined, and six were found deficient. It was found that the correct quantity of the drug was measured or weighed, but the water was simply added in amount sufficient to fill the bottle, it being assumed apparently, that its capacity is accurate. In one sample of reputed six-ounce bottles it was found that they contained on an average 5½ drams in excess of this quantity, equal to 11·25 per cent. Obviously, if the dose be measured the quantity of the drug will be diminished to this extent. To insure accuracy the water should be measured as well as the drug. It is not suggested in the report that the chemists concerned intended in any way to defraud or deceive the public. The error was due to want of thought and will doubtless be rectified now that attention has been officially directed to it.

Working Expenses.—The accounts of the railway companies for the past half year, now complete, show that there has been a moderate expansion in net earnings, not, however, in proportion to the increase in gross receipts. Whilst the gross earnings of the nineteen leading companies show an increase of 3·06 per cent.—the normal rate of growth being rather under 3 per cent.—net earnings have improved by only 1·9 per cent. Working expenses have absorbed much of the increased revenue. These expenses have been increased by (1) the rise in the price of coal; (2) advance in the price of material; (3) increase in wages; (4) betterment. Taking the twelve leading companies, it will be found that the increase in the total expenses of the half year was very much larger than for the corresponding six months of any of the preceding six years. Last year it was only £835,700; this year it was £1,186,000. The largest item in this increase is wages. For example, the wages bill of the London and North Western for the six months has increased—comparing last year with this—from £1,955,000 to £2,020,000; of the Midland from £2,052,000 to £2,136,000; of the Great Western from £1,588,000 to £1,666,000. The aggregate wages bill has increased by over £419,000, to which all have contributed with the exception of the London, Brighton and South Coast Railway, which shows a slight decrease from £368,000 to

£365,000, due to the necessity for economy even in wages consequent upon the great falling off in traffic. Next to wages, and for the moment excluding coal, the next most important item of increase is in the cost of materials. Under this head the aggregate expenditure of the twelve companies has increased £224,000. Rates and taxes make up the one item showing a decrease amounting to £58,000, or a trifle over 3 per cent. A heavy item of increase is in coal, the increase being from £2,191,000 to £2,512,000, an increase of £321,000, or about 15 per cent. The London and North Western coal bill has increased from £439,000 to £470,000; the Midland from £309,000 to £367,000; the Great Western from £294,000 to £344,000. The train mileage run shows an increase of 4,480,000 miles, or about 3 per cent. as against gross increase in the receipts of these twelve companies of about 4 per cent Fortunately, receipts for the most part showed substantial expansion, and consequently of the nineteen leading companies five have been able to increase their dividends for the past year, and ten to maintain them, four only having to reduce their distributions. The increase in capital outlay was less than usual, and in the present mood of the investor, with working expenses likely to be still further and seriously increased in the near future, directors of railway companies will, doubtless, consider it advisable to reduce their capital expenditures to the lowest possible figure.

A Cotton Trade Dispute. — Dispute has arisen between the Cotton Employers Federation and the Oldham Operatives Spinners Association upon a novel point. It was recently agreed that an advance of 5 per cent. should be paid to spinners and card-room workers. Hitherto, advances have been calculated and paid on the standard wages list, which has been in operation in the cotton districts for some years. But at present the operatives are receiving more than the standard rate, and they claim, therefore, that the advance shall be calculated from the current wages, and not from the standard rate. The employers object, and on Friday last a joint conference of representatives of masters and men was held in Manchester in the hope of arriving at a settlement. But this was not affected. The employers maintained their opposition to the claim, and the spinners will consider what further action, if any, they will take.

The Wool Trade. — The comparative ease with which the immense wool imports of last year have been absorbed is surprising. The Australian increase was 208,000 bales, mostly wools of merino quality, and the whole has been taken at very high prices. Fine wools and the tips made out of them are the firmest market. Naturally, estimates vary considerably as to what the increase in the output of Australian wool will be this year. With the exception of New South Wales, very good results are anticipated. Some estimates put the increase during the present wool year at about half that of 1906-7, whilst others reach last year's figures. It is early as yet to estimate what will happen between now and the end of June next, but with prices much above an average, supplies of Colonial wool the largest on record, and another probable large increase during the present season, consumers are not likely to hold large stocks. Prices are, on an average, more than 2d. a pound lower than last year, and there may be further decline. The great devastation caused by rabbits, in Australia, may be noted. It is difficult, says an Australian correspondent, to over estimate the evil results of this scourge. When water is abundant, and feed green, little or nothing can be done to stay the plague. Another serious evil is the increased number of foxes. Less than a generation ago, a lover of sport turned out specimens of this vermin within a few miles of Melbourne. Already they are to be found in all possible directions within 750 miles of the place where they were turned out. It is not uncommon for farmers in the best portions of Victoria to kill ten or more foxes in a single week. One farmer, with 100 lambs nearly ready for sale, is said to have had half of them killed in a single night.

The Belfast disturbances have caused a good deal of inconvenience to wholesale drapery houses in England, and to their retail customers in some parts of Ulster. Little relief has been obtained from other linen centres, so that the distribution of linens received a serious check. Fortunately the quarrel has been adjusted, and it may be hoped that it will be long before there is anything like a repetition of the late lamentable occurences.

GENERAL NOTES.

Marking Fish in Iceland.—In his report on the trade and commerce of Denmark, just issued (Cd. 3283-123), Mr. Lionel C. Liddell, His Majesty's Consul at Copenhagen, refers to some interesting experiments lately conducted by Dr. Johs Schmidt in marking plaice and cod off Iceland. Plaice to the number of 774 were marked, and 29 of these were re-caught—18 by the British, 6 by the Germans, and 5 by the Icelandic fishermen. Of 908 marked cod, 38 were caught. As only small cod were marked, the fish were caught by the coast fishermen in open boats. By means of these researches it is pointed out that it is possible to obtain some insight into the habits of the fish. Mature plaice leave the cold water off the north and east coasts of Iceland and seek the warmer water off the south and west coasts, in order to breed. The marked cod, which are not mature fish, remain in the cold water; but on attaining maturity they, like the plaice, go to the south coast to breed, *i.e.* to their place of origin. From Dr. Schmidt's observations it appears that the cod invariably spawn in the warmer waters of the south and west coasts, and the eggs and young are driven thence in a north and westerly direction. It is of

importance to have the knowledge that the cod live in the cold water of the north and east coasts from birth to maturity. In these waters trawling is impossible owing to the rocky nature of the sea bed, so that the fear expressed by the Icelandic fishermen that trawling would destroy the cod fishing is groundless.

BRITISH TRADE WITH SWEDEN.—In his report on the trade and commerce of Stockholm (Cd. 3283) Mr. Consul Villiers expresses the opinion that British trade with Sweden might be very much developed. Sweden is a country of great natural wealth, and a period of development is at hand. Most of the exports come to the United Kingdom but only a few of the imports come from here. It is not, says Mr. Consul Villiers, because Sweden is unwilling to buy, but because the traders do not know how to enter into trade with a country practically unrepresented by commercial travellers, while it is easy to enter into arrangements with the agents of the countries who are frequently calling upon them. The recent opening of the Swedish Chamber of Commerce in London may facilitate matters, but more direct steps should, in the Consul's opinion, be taken by British merchants to develop trade. The rise in value of the rated value of real estate in Stockholm is remarkable. Building is very active, and rents are enormous, and still rising. To show how property has risen in rated value in Stockholm, Mr. Consul Villiers takes figures from nine districts which represent the rated value for the years 1859, 1899, and 1904, the totals aggregating £5,135,053, £40,079,385, and £55,626,662 respectively.

TAIREN (DALNY).—Mr. Vice-Consul Parlett's report (Cd. 3283, 115) on the port of Tairen, otherwise known as Dairen, Talien, or Dalny, shows that little has been done by the Japanese to restore the town to its flourishing appearance before the war. Outside the Russian administrative quarter there are hardly any solid foreign-built houses, and the few that exist are mostly relics of the days of the Russian *regime*. The Japanese are, it is true, erecting a good many buildings, but they are poor in quality and the materials used. The greater part of the town, which was planned by the Russians on a very ambitious scale, still remains waste ground; and such streets as do exist, are occupied almost entirely by Japanese or Chinese shops, and dwellings of a poor and often squalid description. This remark applies even to the busiest streets. The attention of Japanese investors seems to have been monopolised by the great revival of trade and industries in Japan proper after the war, and to Europeans the place presents no attractions. Moreover, there is the uncertainty of tenure—Land or buildings may, by the rules now in force, be confiscated at any moment at the discretion of the authorities, one week's notice being given in the case of buildings, one month's in that of land. In addition, a lessee may not transfer his lease to another party, nor may he mortgage his rights as security for debt. The authorities indeed assure would-be lessees that the first of these conditions will never be enforced, but that is not sufficient. The merchant naturally asks why, if this be the case, the rule is not struck out.

TRADE WITH ICHANG: A SUGGESTION.—In his report on the trade of Ichang (Cd. 3283-142), Mr. Consul Little repeats what he has said in previous reports that business cannot be done by sending, as English traders are in the habit of sending, catalogues in English of all sorts of goods. It would, he says, save time, trouble, and expense, if merchants would apply in the first instance to the commercial *attaché* at Shanghai for advice. The recent receipt of an elaborately illustrated catalogue of furniture has, however, suggested to Mr. Little an idea which may possibly have something in it. British consulates in China are entirely unfurnished, and officers have to provide everything. The distances to be covered being enormous, a single journey sometimes amounting to 2,000 miles or more, with five or six transhipments, and transfers frequent, ordinary furniture does not last long. It has occurred to Mr. Little that if it were possible to make at a moderate cost steel furniture which would stand rough handling and yet be of attractive appearance, not only would British manufacturers be able to secure a considerable business now in the hands of Chinese, but a great boon would also be conferred upon consular officers and others similarly situated. To obtain the best results, the bulky articles should be made in pieces, so as to facilitate packing, or else constructed to hold the small miscellaneous things required in housekeeping so as to economise space.

COLOMBIAN BANANAS. — Reporting upon the trade and commerce of Barranquilla and Cartagena (Cd. 3283, 145), Mr. Consul Gillies says that, owing to an increased demand, thre has been an enormous development during the last few years in banana cultivation. The banana enjoys great advantages over the other products of the county in that it is more easily cultivated, and is not burdened with the large freight expenses which makes the export of coffee and other articles grown in the interior so expensive. A good deal of land has recently been bought in the neighbourhood of Santa Marta for the cultivation of the banana, and both native and foreign capital is being largely invested in the business. The United States is still the largest consumer, but there is now a good market in Europe, and it is increasing year by year. The bananas produced in the district are contracted for by the United Fruit Company of New York, and are shipped to that port weekly by vessels of the Hamburg-American line, which are specially chartered for the purpose. From all accounts the cultivation of the banana is a most lucrative investment, and the prospects for the future, in view of an ever increasing demand, are bright.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

MULREADY PRIZE.

The Council of the Society of Arts are prepared to offer, under the terms of the Mulready Trust, a Gold Medal, or a prize of £20, for competition amongst students of the Schools of Art of the United Kingdom, at the Annual National Competition to be held in 1908.

The prize is offered to the student who obtains the highest awards in the following subjects:—

(*a.*) A finished drawing of imperial size from the nude living model.

(*b.*) A set of time studies on a small scale, from the nude living model, executed in a short time, of varied shortly sustained poses (mounted on not more than two imperial size mounts).

(*c.*) A set of studies of hands and feet from the living model (mounted on not more than two imperial size mounts).

(*d.*) Drawing from the life, including memory life drawing done at the Examination in May, 1908.

No student will be eligible for the award who does not pass in the Examination (*d*) in drawing from the life, and who does not obtain an award for (*a*) the finished drawing of imperial size from the nude living model. The other two subjects are optional.

The works must have been executed between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1892, 1893, 1896, or 1903, cannot compete again.

The drawings, &c., are to be submitted, with other school works, in the usual manner to the Board of Education, South Kensington, in April, 1908. Each competing drawing must be marked "In Competition for the Mulready Prize," *in addition* to being labelled according to the Regulations of the Board of Education.

SECTIONAL COMMITTEES.

INDIAN SECTION COMMITTEE.

The following is the list of the Indian Section Committee, as appointed by the Council:—

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E. (Chairman of the Council).
Sir William Lee-Warner, K.C.S.I. (Chairman of the Committee).
Sir Frank Forbes Adam, C.I.E.
Lord Ampthill, G.C.S.I., G.C.I.E.
Sir Athelstane Baines, C.S.I.
Colonel Sir David William Keith Barr, K.C.S.I.
Thomas Jewell Bennett, C.I.E.
Sir M. M. Bhownaggree, K.C.I.E.
Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D.
Sir James Bourdillon, K.C.S.I.
Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I.
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Sir Charles A. Elliott, K.C.S.I., LL.D.
James Fairbairn Finlay, C.S.I.
Sir Frederic W. R. Fryer, K.C.S.I.
Lord Harris, G.C.S.I., G.C.I.E.
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Sir James Lyle Mackay, G.C.M.G., K.C.I.E.
Sir Patrick Playfair, C.I.E.
John David Rees, C.I.E., M.P.
Right Hon. Sir Joseph West Ridgeway, G.C.M.G., K.C.B., K.C.S.I.
Field-Marshal Earl Roberts, K.G., K.P., G.C.B., G.C.S.I., G.C.I.E., V.C.
Alexander Rogers.
Sir Edward Albert Sassoon, Bart., M.P.
W. S. Seton-Karr.
Sir Charles Cecil Stevens, K.C.S.I.
Colonel Sir Richard Carnac Temple, Bart., C.I.E.
Carmichael Thomas.
Sir James Thomson, K.C.S.I., M.A.
Thomas H. Thornton, C.S.I., D.C.L.
Sir Charles A. Turner, K.C.I.E.
Alexander Falconer Wallace.
Sir George Watt, C.I.E., M.B., C.M., LL.D.
Sir Raymond West, K.C.I.E., M.A., LL.D.
Field-Marshal Sir George Stewart White, G.C.B., G.C.S.I., G.C.M.G., G.C.I.E., G.C.V.O., V.C.
Arthur N. Wollaston, C.I.E.
Lieut. Colonel Sir Curzon Wyllie, K.C.I.E., C.V.O.
Colonel Charles Edward Yate, C.S.I., C.M.G.
S. Digby, C.I.E. (Secretary).

IMPROVED METHODS OF DUST PREVENTION IN THE GRINDING TRADES.

By Samuel R. Bennett, M.A.

In the course of an investigation carried out by the order of Dr. Whitelegge, Chief Inspector of Factories, Home Office, with a view to devising methods of removing and allaying dust arising in the Sheffield cutlery and kindred grinding trades, some improvements have been made on the existing methods. Two of these improved methods are noteworthy, because their effects are far reaching. They are (1) a wet method of "racing" grindstones when first hung, and (2) an improved form of hood for catching dust, &c., given off in the processes of dry grinding.

Many varieties of grindstones are used in Sheffield. Some are huge masses, seven feet in diameter when new and twelve inches or more in thickness, and are used in saw-grinding, &c. Others are used when little more than seven inches in diameter and one inch across. Some are almost of a flinty hardness, whilst others could almost be crumbled in the hands.

The troughs in which the stones revolve are sunk into the floor so that approximately three-fifths of the stone is above the floor level, allowing for the spindle bearings over the trough. All stones are hung on spindles and centred thereon. This centering, when the stones are small, is done by means of wedges between the spindles and the central holes in the stones. For almost all wet stones above twelve inches in diameter circular side-plates are used. These are screwed up against the sides, after the rough quarried stones have been approximately balanced on the axles. The remaining irregularities, chisel-marks, eccentricities, &c., from the true cylinder, are removed by the process of "racing." To perform this operation the grinder places a short piece of wooden plank close to the face of the slowly revolving stone. Using an iron or steel rod pointed at the end as a lever he firmly holds the point against the stone; thus the projecting parts of stone are broken away. By rolling the lever on the plank the whole face of the stone is trued up. The sides are then similarly dealt with.

Up to the present time racing has been done with the stone and apparatus in a dry state. Any person who has been in a grinding hull or room whilst dry racing was being done will have experienced the suffocating clouds of swirling dust which penetrate to every corner. The dust is almost wholly siliceous, and has an irritant effect on the nostrils and throat. It covers thickly everything and everybody in the hull. Much remains suspended in the air for over an hour after the racing is finished. The baneful effect on the lungs of the grinders is easily understood.

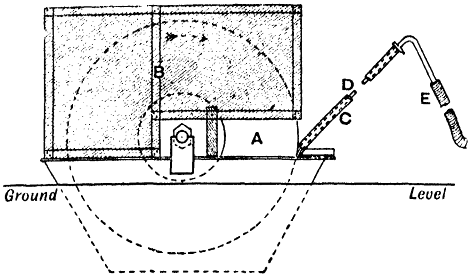
Mr. C. F. R. Johnston, H.M. Inspector of Factories, and the writer tried many kinds of apparatus—some ingenious, some expensive, most of them cumbersome—for racing a grindstone without making much dust. We found none that came within our requirements. At length we devised the following method which has the merits of being effective and cheap, and has in addition the great boon of allaying the dust almost or quite completely—a boon to grinders and machinery owners alike.

The apparatus consists essentially of an iron or steel pipe of any convenient dimensions (say, about four feet long, and about half an inch internal diameter). A piece of ordinary half-inch gas-piping has been found to answer well. Almost completely through this pipe one of smaller diameter is passed. By means of a bend, swivel or otherwise this inner pipe is connected to a flexible hose-pipe through which a supply of water can be obtained. The inner pipe may be adjusted within and prevented from slipping through the outer one by means of a collar and set-screw, sleeve, or other simple device. In conjunction with this pipe is used a box over the grindstone, to prevent splashing. This box is preferably of the length and breadth of the trough, and of such height as to allow the stone to revolve freely underneath. It may be made of wood, iron, or other waterproof material. We have found that a wooden framework covered with waterproof oiled cloth suited admirably. About nine inches deep of the lower portion of the sides and end of the box are cut away opposite to those parts of the face and sides of the grindstone where the racing tool is to be used, and to allow for the axle and bearings. It can be supported in any convenient way to make up for this.

Racing is performed with the gas-pipe in a similar manner to that with the ordinary racing-steel. A jet of water passing through the inner pipe plashes on the stone and mixes intimately with the stone dust immediately on disintegration. The amount of this water supply depends on the size and quality of the stone: a rate of a little less than one gallon per minute has been found sufficient for a stone nearly four feet in diameter, of moderate hardness.

The accompanying figure will explain the appliance.

WET RACING APPARATUS.



A = Grindstone. B = Splash Box.
C = Racing Pipe. D = Inner Tube.
E = Flexible Hose (to Watertap).

When a grinding-stone revolves with a high angular velocity a considerable whirl is produced by friction with the air in the immediate neighbourhood of the stone's periphery. If an article be pressed on its surface whereby particles of the stone and of the article are disintegrated, it will be found that the heaviest particles fly off in or near the direction of the tangent to the wheel at the grinding points. As we proceed from this tangent in the direction in which the stone is revolving, the particles get finer until some of the finest particles are carried right round the wheel by the whirl produced by the periphery of the stone. The behaviour of these particles varies according to their mass, density, the speed at which they are thrown off, and the neighbourhood of interfering objects or forces. To consider this behaviour the whole spray of particles may be divided into four classes :—

1. The heaviest, which fly nearly in straight lines for some distance, and then fall to the ground.

2. Those whose initial velocity diminishes rapidly, float about for a short time, and then settle down near the stone.

3. The lightest, which swirl from the peripheral current and float about, wafted by every eddy all over the room in which the grinding is done.

4. Those which are carried completely round the stone, and impinge again on the body or hands of the grinder, or on the article ground.

The proportions of each of these four classes in any particular case depend on :—

(*a*) Position, nature, size, shape, and speed of the stone.

(*b*) The nature, variety and size of the articles being ground.

(*c*) The amount of movement and pressure of the article on the stone.

(*d*) The situation of neighbouring objects.

(*e*) The currents of air in the room affecting the particles.

Perfect ventilation is only secured when all four classes of particles are carried away, throughout every stage of the stone's wear. This must be done in such a manner that the progress of the work in hand is not impeded by reason of—

I. Obstruction of free movement of the grinder.

II. Obstruction of free movement of the article being ground.

III. Interference with the grinder's clear view owing to the lighting of the grinding surface being cut off.

IV. Difficulty of removing the appliances fitted round the stone, to attend to it keeping in condition.

These four sets of conditions have to be satisfied in general, and in particular when the effective ventilation of any stone is being considered. The relative importance of the various conditions depends on the trades considered. In some trades the question of lighting is of prime importance, in others, of secondary, as the sparks generated by the grinding illuminate the stones sufficiently.

The removal of metallic and siliceous dust produced in quantity by rapidly revolving wheels or grindstones in the processes of grinding and glazing has always been deemed necessary for the good health of workers in these processes and those working in the same rooms. To effect such removal centrifugal fans have been almost invariably used, with ducts sucking air from the neighbourhood of the stones or wheels. Many fan plants have failed completely because, relying on the analogy of gaseous fumes, the installers have attempted to deflect the heavy dust particles by the air-suction current alone.

Observation of the actual processes, and consideration of the *vis viva* of the particles thrown off, have led to the conclusion that owing to the high initial velocity of the articles, approximating in most cases to a mile a minute, it is impossible effectually to remove dust so geherated by the deflecting power of an air current alone. In other words, it is necessary to catch the flying particles, to destroy to a large extent their initial velocity, and then to deal with them by the air current. The larger the particles given off in grinding the greater the force with which this

principle must be applied. This general principle, obvious when demonstrated mathematically, was, I believe, first enunciated in a practical manner quite recently by Mr. H. H. Cunynghame, C.B., a member of the Council of the Society of Arts. One is almost forced to conclude that this principle has been unknown to all, or certainly to the great majority of ventilating engineers, judging from the construction of the plants installed. As a rule attempts have been made to catch one or two of the four classes of particles, usually the first two. In order effectively to remove these without obstructing the lighting of the grinding surface, the hood fitted to the extremity of a fan-duct opposite a stone has been placed at a comparatively great distance. Thus the third class of dust is only partially deflected, whilst the fourth is left unaffected. The consequence is that the most deleterious dust is left to be inhaled by the workers.

Again, sometimes the hood is fixed so as to intercept classes 2 and 3, leaving classes 1 and 4 in the working room.

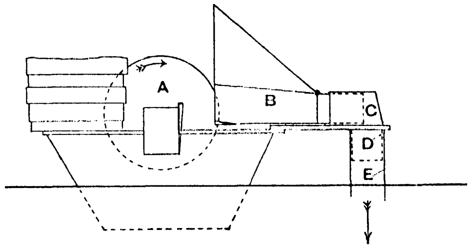
In no case has a hood capable of adjustment so as to intercept the fourth class been fitted, allowing at the same time of the grinding surface being illuminated.

Founded on the foregoing considerations, the following novel form of hood for dry grinding of razors, scissors, forks, augers, gimlets, &c., was devised by Mr. Johnston and the writer. It has been tried and found effective in many instances.

It consists of a board or plate having a hole at one end, and means of connecting this aperture so as to form an air-tight joint to the fan-duct. Over this aperture is fixed a pipe of slightly larger area than the air-duct. Into this slides a similar pipe on to which a suitably shaped hood is fitted. This hood, which may have its top and sides constructed with glass panes to allow light to pass to the grinding surface, is kept with its lower edge close to the stone, and preferably overlaps the stone on either side. The device depends for its efficacy on the following points of construction. First the height of the opening is such that the upper edge is above the tangent to the stone at the furthest backpoint on the stone at which grinding may be done, thus catching class 1 dust; second, the width is the minimum consistent with the width of the stone and the extent to which dust is ejected sideways by oblique grinding; third, the slope of top and sides is allowed for, so that all particles shall strike the hood at an oblique angle and be reflected further into the hood; fourth, the bottom comes close up to the stone, thus deflecting the air and fine dust whirl of the stone periphery and sides towards the duct; fifth, the top and sides may be constructed of easily removable strong sheet glass, ensuring translucency, with wire netting on each side to prevent fracture; sixth, as the stone wears down, the hood can be drawn forward so as to intercept class 4 dust throughout the stone's wear; seventh, the hood may be made capable of a second adjustment on the fan-duct; the top of the hood may have hinges at its juncture with the sliding pipe, and so be raised or lowered as the size of the stone requires.

The accompanying figure will illustrate the appliance.

ADJUSTABLE HOOD.



A = Grindstone. B = Adjustable part of Hood.
C = Fixed part of Hood. D = Adapter to Fan Pipe.
E = Fan Pipe.

GEOGRAPHY AND COMMERCE.*

Peculiar importance in commercial geography is given to the relations between the regions that yield or yielded spices and those in which they were consumed at a great distance from the place of origin, and one of the most important facts in human history is that for many hundreds of years an extremely valuable trade in these commodities was carried on between India and the Mediterranean. Spices, no doubt, were less talked about, less prominent as symbols of wealth, than gems and jewels, fine woods and ivory, but they formed the basis of a larger trade, which was in the aggregate probably more profitable than that in the still more costly wares.

The geographical relations between India and the Mediterranean necessarily determined the routes followed by this traffic. These routes were singularly few. They were practically confined for the most part to minor variations in two main routes, one by way of the Red Sea, the other by the Persian Gulf. At more than one period of history, in very early times,

* Abstract of the address of George C. Chisholm, M.A., B.Sc., President of the Geographical Section before the British Association, at Leicester.

in the days of the splendour of Assyria and Babylonia, and again in the flourishing days of the Caliphs of Baghdad, the Persian Gulf route had a peculiar advantage in the existence of the large and rich populations that afforded an intermediate market; and another important fact in the relations of geography and commerce, one that has had vast effects on human history, is that the physical conditions of the area between the head of the Persian Gulf and the Mediterranean are, and throughout human history have been, such as to make the most convenient outlet of that route some point or points on that seaboard which in ancient times was known as Phœnicia. Between that seaboard and the Euphrates the desert is sufficiently narrowed to be most easily crossed. The most favoured outlets on this seaboard were not always the same. They varied in different circumstances, which gave a different geographical value now to one point, now to another.

Although the geographical conditions for a long period of time led to a special accumulation of the wealth due to commerce on Phœnicia, Phœnician trade promoted the growth of wealth and civilisation elsewhere. The Greeks of the Ægean distinctly recognised what they owed to the Phœnicians, and they in their turn derived much wealth from Eastern trade, even though not so directly as the Phœnicians, and they in their turn derived some of the food for a commercial population from the far west—from Syracuse, Sybaris, and even the distant Kume. But the far east had a peculiar fascination. As the articles from which much of the wealth of commerce was derived originally came from India, it was natural that the idea should arise that India was a wealthy country, a country well worth possessing. I am not aware whether India ever was in historical times a wealthy country in the sense of producing a great abundance of the necessaries and ordinary conveniences and comforts of life in proportion to the population, but if it was not rich itself it was at least the means of making others rich. There can hardly be a doubt that the desire of possessing this country of real or imagined wealth was prominent among the motives that led Alexander the Great to embark on that enterprise which had such surprisingly—one might almost say miraculously—widespread, profound, and lasting effects on the history of the Near East.

At the outset of his career Alexander had destroyed Tyre, thinking, no doubt, that he had thereby wiped away the claims of one rival for a share of the wealth of the East; but it is a noteworthy fact that he did not thereby destroy the value of the site of Tyre under the conditions which then subsisted. Tyre revived and again obtained wealth from its trade with the East, as it did again and again in subsequent history. A heavier blow to Tyre than its mere destruction was the ultimate accomplishment of Alexander's idea for founding a great seat of commerce on the harbour which he saw could be created in the neighbourhood of the Nile delta. The foundation of Alexandria and the successful efforts of the successors of Alexander in Egypt to divert a large part of the trade in spices and other Oriental goods to the Red Sea route for the Mediterranean did more than a single act of war to deprive Tyre and other Phœnician cities of the peculiar pre-eminence which they had long enjoyed in the trade in those wealth-bringing commodities.

But perhaps the history of Venice shows even more clearly than that of Tyre the importance of this eastern trade in connection with certain inevitable geographical relations. The foundation of the future commercial glory of Venice may be said to have been laid when Rome planted her colonies north of the Po. The gradual clearing of forests gained for agriculture to a greater and greater extent one of the most favoured agricultural areas in Europe. There resulted a superfluity of agricultural products, which begot a trade by sea. Gradually commerce grew, until in the eighth century we find the Venetians trading with Syria and Africa, Constantinople, and the ports of the Black Sea.

Throughout the period of growth the policy of this trading republic, both by land and sea, is very significant. Venice early realised the force of Bacon's maxim, "that he that commands the sea is at great liberty, and may take as much and as little of war as he will." Power at sea was necessary to provide security for her commerce. In her early times she generally owned allegiance to the Eastern Roman Empire, a suzerainty which could do her little harm and could and did do her much good. To that allegiance she adhered until she was strong enough to turn against and reap advantage from the overthrow of her suzerain. At an earlier date, before the close of the tenth century, she had conquered Dalmatia, and thereby destroyed the hordes of pirates who had found refuge in the innumerable harbours of that coast and constantly harassed the commerce of the Adriatic. At every opportunity she secured establishments and acquired possessions in the Levant.

As a last illustration of the nature of the relations of Venice to the North Italian plains we may refer to some of the points mentioned in a celebrated and often quoted address delivered to the principal senators of Venice by the Doge Mocenigo just before his death (1423), at the time at which Venetian trade was at the very height of its prosperity. At that time Venice was in possession of a considerable tract of adjacent territory on the mainland, and there was a party favourable to further action on the part of Venice against the growing power of Milan. The aged and sagacious Doge feared that this party was going to gain the upper hand and elect as his successor Francesco Foscari, who, he thought, would involve them in dangerous and disastrous as well as useless enterprises. The immediate occasion of the conflict of views in the Venetian Senate was a request of the Florentines for support against alleged designs of the Duke of Milan. Mocenigo, however, not only warned the senators in the most earnest and urgent language against Foscari personally, but also advised them against the particular enterprise, maintaining

that it was of no consequence even if the Duke of Milan made himself master of Florence, since the artisans of Milan would continue to send their manufactures to Venice, and the Venetians would be enriched to the loss of the Florentines. He then went on to give particulars of the trade of Venice at that time, dwelling specially on the value of that with Lombardy. To Lombardy alone, it appears, Venice sold every year cloths to the value of 400,000 ducats, *tele* (? linens) to the value of 10,000 ducats; wools of France and Spain to the value of 240,000 ducats, cotton to the value of 250,000 ducats, wine to the value of 30,000 ducats, cloth of gold to the value of 250,000 ducats, soap to the same value, spices and sugar to the value of 539,000 ducats, dye-woods to the value of 120,000 ducats, other articles 110,000 ducats; in all, goods to the value of more than 2,500,000 ducats, the profit amounting to quite half a million ducats. With the exaggeration that comes natural to a lover of his country Mocenigo goes on to say rather grandiloquently that to the Venetians alone land and sea were equally open; to them only belonged the carriage of all riches; they were the providers of the entire world.

The clearest evidence of the supreme importance of the Indian trade to the Italian cities is to be found in the results of the discovery which finally diverted from Venice and the Mediterranean the great bulk of the Indian trade until that trade had lost all the special significance which it had retained for thousands of years. It need hardly be said that I refer to the discovery of the sea way to India by the Portuguese in 1497-9. Efforts to avert the results of the great achievement of the Portuguese were vain. Other disasters befel the Republic about the same time. Not only was commerce taking another direction, but, says Romanin, "the wars of Italy were emptying the treasury, the Turkish power was despoiling the Republic step by step of its possessions beyond the sea, and Venice was beginning to descend that incline which was to reduce it to a subordinate position among the powers of Europe." North Italy generally suffered at the same time. The withdrawal of the greater part of the spice trade, by diminishing the growth of wealth among the inhabitants, made that part of the world a less important market for manufactured goods. Countries outside of Italy, where rival manufactures had already started, were increasing their wealth more rapidly, and thus imparting an increasing stimulus to their manufactures, and these increased while those of Italy declined. In 1338 the number of woollen factories in Florence is given at 200, making in all 70,000 to 80,000 pieces of cloth in the year; in 1472 the number of shops or factories had risen to 270, but no estimate is given of the quantity of the product; in 1529, however, the number of shops is said to have sunk to 150, and the quantity of cloth manufactured to 23,000 pieces per annum, and in the latter half of the eighteenth century the quantity was only about 3,000 pieces annually.

The main point on which I want to insist is that, whatever the commodities were, whether carried out or home, the nature of the trade with the East was little if at all altered by the discovery of the direct route to India by sea. The trade still continued to be one concerned in a moderate number of articles of small bulk but high value. It was merely a change of route that the Portuguese effected, and for more than a hundred years they remained in sole command of this route. After that, however, they were ousted from the greater part of this trade, and that the more valuable part, chiefly by the Dutch, and from a geographical point of view it is very interesting to note how the Dutch did it. They did not trouble themselves much about India proper. They left the Portuguese alone at Goa, and from that port as a base allowed them to pick up as much trade as they could at Calicut and Cochin, which, said Albuquerque, "were capable of supplying the Portuguese fleets until the Day of Judgment." But Malacca, on the straits of that name, gave command of the route to the further East, whence came in the end even larger quantities of pepper than could be got from India, whence came too ginger, cloves, and nutmegs, as well as the products of China. The importance of this place Albuquerque had accordingly recognised, and in 1511, the year after he took Goa, he took it also by the right that always belongs to the lion as against the jackal. This place was taken by the Dutch (1641), who had previously established themselves on Java and the Spice Islands, where they maintained an absolute monopoly. Ceylon, again, was (and is) almost the only place from which the true cinnamon was to be obtained, so the Dutch took that island also from the Portuguese (1656). As long as the Portuguese were the sole Europeans in the East, Calicut and Cochin not merely furnished the Portuguese with Indian wares, but were important entrepôts for the spices, perfumes, drugs, and jewels of the Further East as well as of Chinese silks and porcelains; but the trade in these commodities could be wholly or largely diverted to places in the possession of the Dutch. Even before the capture of Malacca and Ceylon a Portuguese Viceroy had reported (1638) that the Dutch had a monopoly of trade from the Bay of Cochin China to the Point of Sunda.

But this change also was little more than a change of route. The general character of the Eastern trade remained the same. The English East India Company, whose operations, through the hostility of the Dutch, came to be restricted to India proper, there founded a trade that gave much more opportunity for expansion under modern conditions than that of the Dutch, but for a long time it retained the same character. All the commodities enumerated by Colquhoun as brought back by the voyages of 1620-3 in exchange for the bullion and merchandise sent out were pepper, cloves, mace, nutmegs, Chinese and Persian raw silk, besides calicoes, the sole manufactured article, and one of course that had relatively

a much higher value than now, when the direction of the trade in that commodity is reversed.

A similar character for a long time belonged to the trans Atlantic trade, even though the costs of transport in that case were less, and favoured the development of a trade in somewhat bulkier commodities. Furs from the Far North, tobacco from Virginia, sugar, and afterwards coffee and cotton from the West Indies, were by far the most prominent imports. It was the tobacco trade of Virginia that first enabled Glasgow, which at the time of the union of the English and Scottish Parliaments was an insignificant town with less than 13,000 inhabitants, to convert itself into a seaport, and thus lay the foundations of its subsequent prosperity. Now tobacco makes up less than 1 per cent. of the value of the goods imported at Glasgow, and, though that may be partly due to a diminution in the actual quantity of tobacco imported at Glasgow, this result has chiefly been brought about by changes in relative values. A hundred years ago the value of the imports into Great Britain and Ireland from the British West Indies was about one-fourth of the total value of the imports from all parts; now it is less than 1 per cent. of that value.

What has brought about such changes, what makes the essential difference between recent and all previous commerce, is the series of enormous improvements in the means of communication which followed so closely on the invention of textile machinery and the improvement of the steam-engine in this country. These improvements have had two important effects on commerce. First, they have facilitated the maintenance of order and security both by land and sea, and thus enormously reduced the risks of commerce. Secondly, they have directly lowered the cost of transport for different goods in different degrees. Bulky goods of little value could now for the first time be profitably conveyed many hundreds of miles by land to a seaport, and there load ever larger ships for distant shores, thus opening up markets with vast undeveloped resources in the heart of great continents. Along with these bulkier goods the more valuable goods are carried at a cost far below that of former times, so that for such commodities as pepper the mere freight is almost a negligible item.

CAMPHOR PRODUCTION IN FORMOSA.

The manufacture of camphor in Formosa is confined to trees of upwards of fifty years of age. The Camphor Bureau prohibits the cutting down of trees of less age than fifty years. Although inquiries as to the number of old trees in the island are not as yet completed, the number of these trees is far less than was stated a few years ago. Recent investigations warrant the statement that the supply of old trees will, at the present rate of cutting, become exhausted in less than fifty years. The old trees now standing are confined to the moutainous eastern half of the island, in regions for the most part part still under the control of savage tribes. The work of subjugating these tribes is difficult, and one requiring much time. At the present rate of subjugation it will be many years before their territory can be safely exploited. Besides the subjugation of savage taibes, there are other difficulties to be overcome. The mountains are covered with dense jungles, and the work of building roads in order to render the camphor forests accessible to profitable exploitation is one requiring the expenditure of much labour and time. Moreover, the sanitary conditions throughout much of the territory are such as to materially reduce the efficiency of labour employed therein. A Japanese company took one thousand coolies into the Daito district a few years ago for the purpose of exploiting the camphor forests. Reports from this company state that 33 per cent. of its labour is incapacitated through the contraction of fevers. Last year twelve of its men were decapitated by head-hunting savages. At present, according to the American Consul at Tamsui, the greater part of the camphor produced in the island comes from the trees in the Toen prefecture. With prosperous conditions obtaining throughout the civilised portions of the island, there is naturally a reluctance on the part of the coolie labourer to risk attacks by savages in working in the camphor forests at a wage equivalent to about 1s. 8d. a day, when he is enabled to secure half this amount in the more peaceful pursuits on the lowlands. Thus the difficulties to be overcome in order to exploit the remaining camphor forests of the island are such as to render the cost of securing the product a constantly increasing quantity. The Camphor Bureau of the Formosan Government expects to produce 6,667,000 lbs. of crude camphor, and about one-half that amount of camphor-oil during the present year. They expect to produce a similar quantity each year during the next few years, with probabilities of a slight increase thereafter. It is said that Formosa at present produces about 75 per cent. of the world's supply of camphor, the remaining 25 per cent. being produced by Japan and China. Until Japan took possession of the island, practically nothing was done to replace the trees cut down, except what was done by nature itself. The camphor tree grows readily from seed, and requires but little attention. Since the organisation of the camphor monopoly in 1899, the Formosan Government adopted a system of afforestation which it is hoped will result in guaranteeing to the island a constant supply of raw materials. The Camphor Bureau provides three methods of afforestation—Government replanting, replanting by schools, villages and agricultural societies, and replanting by private concerns Up to the present year the securing of seeds was difficult. While the Formosan trees are good seed producers, yet owing to the fact that the seed ripens quickly, and if not picked within two days after it blows away, much difficulty has been experienced in col-

lecting seeds, as the trees were not afforded the proper protection. Owing to the large export of Japanese seeds to foreign countries, the Formosan authorities could not depend upon Japan for a supply. The Camphor Bureau now designates and registers certain of the seed-producing trees and prohibits them being cut down; in this manner a plentiful supply of seeds is being provided for. Agricultural experiment stations are maintained throughout the island, and to these is assigned the task of planting the seeds and providing nurseries for the young plants. The young plants are taken from these nurseries and replanted in districts set apart for that purpose. It required several years to secure sufficient trained coolie labour to attend to the setting out of these trees. Since 1900 the Government has planted about 3,000,000 young trees, and has arranged to add 500,000 to their number during the present year. It is expected to be able to plant 750,000 each year after the present year. Trees planted in the mountainous districts are set out with the idea of prohibiting their utilisation for camphor production for a period of 40 or 50 years. Those which are planted on the lowlands are set close together in rows with the idea in view of utilising their leaves, after they have attained a ten years growth in the manufacture of the crude camphor. The lowlands planted in camphor are designated as camphor gardens rather than as camphor forests. Beyond an occasional clearing of the ground about the young tree, it requires no attention in the way of cultivation or irrigation. There are many varieties of worms which attack the young plants, but the Government experts report that but six trees, out of many thousands planted, die. There are two varieties of trees—the camphor-producing tree, and the camphor-oil producing tree. The former is the more valuable. It requires an expert to detect the difference between these two varieties in the standing trees. The Government nurseries furnish young plants to the schools, villages, and agricultural societies desirous of planting the camphor trees, and many such have availed themselves of this offer. Private concerns in Formosa desirous of engaging in the camphor industry, are also supplied by the Government nurseries with the young plants. Hence it is evident that afforestation of camphor in Formosa is proceeding at a good pace. Reports from Japan estimate the number of trees planted there during the past ten years at 8,000,000. Reports from China state that while the Chinese are interesting themselves in the question of afforestation, up to the present nothing has been done towards the planting of new trees. Crude camphor is manufactured from the wood by the simple process of distillation. Chips of camphor wood are placed in a clay-plastered retort which rests upon a circular wooden rim of a water pan. This water pan is placed over a fire. Connected with the retort, at some distance away, are the crystallisation and cooling boxes in which the camphor vapour passes, is cooled, and crystallised. The camphor thus crystallised is dark in appearance, and is known as crude camphor. Stills or stoves are erected as close as possible to the supply of the raw material, hence there is a very considerable number of them. The products of the different stoves are not uniform in quality. The Monopoly Bureau works in Taihoku a camphor factory, where the products of the various stoves are graded, and by redistillation rendered uniform. This factory produces two grades of camphor, known as "B" and "B B" grades. The "B" grade, that which is exported to the American market, is rated crude camphor, containing a higher percentage of oil and water than the "B B" grade, which more nearly approaches a refined camphor. The "B B" grade differs from properly refined camphor in that it is not clarified. Owing to the fact that the Monopoly Bureau's plant was partially destroyed by fire a few months ago it has been impossible to produce the "B B" grade, and consumers are obliged to take the "B" product until the plant is repaired. The crude camphor which is not exported to foreign markets is sent along with the camphor oil to the Kobe refineries where refining is completed. Although the "B B" grade is rated by the American customs examiners as a refined camphor, yet the Camphor Bureau in Formosa terms it crude camphor, for the reason that a clarifying process is necessary to the completion of the refining. It may be said that Formosa, in conjunction with Japan, holds a monopoly of the production and sale of the world's supply of camphor. Although the customs returns for China show that there were exported from that country during the year 1906 about 12,000 piculs (1,600,000 pounds) of crude camphor, yet the Formosan industry fears no competition from that source. Reports of camphor planting in Ceylon, Florida, Texas, and Mexico do not disturb the prospects of the Formosan products in the eyes of the Formosan authorities. These contend that the more camphor trees there are planted the less likelihood there will be of the successful production of an artificial substitute. Artificially produced camphor seems to be a reality, but it is contended that its cost of production is too great to warrant its being made to enter into competition with the natural camphor. The bulk of the world's camphor production goes into the manufacture of celluloid. It is estimated that about 70 per cent. of all camphor produced is utilised in the manufacture of celluloid. Owing to the difficulties which many manufacturers of celluloid have experienced in securing enough camphor to meet their demands, these have often been obliged to purchase supplies through brokers. The Formosan Government now declares its intention of remedying this state of affairs, to some extent at least. The Camphor Bureau has instructed its selling agents to supply, first and foremost, its customers among the celluloid manufacturers. As Japanese capital is already engaged in the erection of celluloid factories in Japan, it is only to be expected that the Japanese

manufacturers will also come in for their *pro rata* share of raw materials. Each year a contract is made with an agent for the disposal of the products of the Bureau.

OLD-AGE PENSIONS.

There has just been presented to Parliament tables which have been prepared in connection with the question of old-age pensions, with a preliminary memorandum. It has been felt, says a prefatory note, that a collection of various statistics bearing upon different aspects of this question, would be of service, "even if the figures collected are only regarded as material for consideration by those who wish to examine fully into the matter." For the last fifteen years Parliament has been directing its attention, in one way or another, to this question of old-age pensions, and as far back as 1893 there was a Royal Commission on the Aged Poor "to consider whether any alterations in the system of Poor-law relief are desirable in the case of persons whose destitution is occasioned by incapacity for work resulting from old age, or whether assistance could otherwise be afforded in such cases." Then there was the Committee on Old-Age Pensions appointed in 1896, and presided over by Lord Rothschild, followed by the Select Committee on Aged Deserving Poor (1899), the Departmental Committee on Aged Deserving Poor of the same year, and the Select Committee on the Aged Pensioners Bill, 1903. But although various pension schemes for the aged poor in this country were propounded and considered between 1893 and 1903—some of a universal kind, some on a basis of insurance (with or without an element of compulsion), and others involving special conditions, limiting the number of possible pensioners—there is as yet no scheme which has, after consideration by a Parliamentery Committee, taken so definite a shape, and reached so authoritative a position, as that favoured by the Select Committee of 1899 (Mr. Chaplin's), and virtually adopted, with modifications, by the Select Committee of 1903. The present Blue-book, therefore, refers to the question of the numbers which might now be pensionable under the scheme, having regard to the investigations made by the Departmental Committee of 1899-1900. Further, the opportunity is taken of making some observations on points affecting the matter, such as the number and growth of the aged population. In considering these figures, it is necessary to remember the want of actual facts, and of accurate statistics bearing on many of the points. The calculations often rest upon assumptions sometimes open to question. The following Table shows in the briefest possible form the conclusions arrived at:—

Estimated number of persons over 65 years of age in 1901	2,016,000
Deduct:—	
For those whose incomes exceed 10s. a week..	741,000
For paupers	515,000
For aliens, criminals, and lunatics ..	32,000
For inability to comply with thrift test	72,700
Total deductions	1,360,700
Estimated number of pensionable persons	655,000
Total estimated cost in round figures	£10,300,000

Bringing the figures down to the present time, it is estimated that in the United Kingdom, out of a total population of the age of 65 years and upwards, probably numbering some 2,116,000 in 1907, there would be about 686,000 persons qualified for a pension, leaving about 1,430,000 persons of pensionable age who would be disqualified on one or other of the grounds specified in the scheme of Mr. Chaplin's Committee, and that the total cost for the United Kingdom, including 3 per cent., or £313,977, for administrative expenses, would be, in round figures, £10,780,000.

It must be borne in mind that a not inconsiderable section of the population is already in receipt of pensions or superannuation allowances from one source or another, though neither the exact number of persons, nor the proportion of those who are over 65 years of age, can be stated. Under the head of "Army, Navy, and Civil Service Pensions," the Chancellor of the Exchequer, when questioned on the subject last year, gave the number as about 171,815, and the cost at £7,903,369. From a return presented to the House of Commons in 1906, it appeared that 24,244 former employees were, on the 31st March, 1906, receiving pensions or superannuation allowances from local authorities in England and Wales, the largest section of pensioned officers by local authorities in England and Wales consisting of police pensioners, who may be estimated to number about 17,000. Information as to the number of persons receiving pensions or superannuation pay from Friendly Societies is very limited. The general evidence given before the several committees which have considered the question of old age pensions goes to show that old age pay, as such, is comparatively little given; the form of benefit derived by aged members is that of permanent sick pay. From a return of 1898, it appeared that £611,464 was annually derived from endowments applicable to pensions and alms-houses, so far as the Charity Commissioners were cognizant of such charities. This return has recently been brought up to date by the Charity Commissioners, who calculate that the total amount applicable to pensions and alms-house charities in England and Wales is not less, and is probably more, than £661,000 at the present time. Summarising the figures referred to in the foregoing statement, it will be found that they cover 249,213 pensioners, who are estimated to draw in pensions in one year £10,532,256. The present report

assumes as highly probable that the number of persons at present in receipt of pensions, and other similar allowances, from one source or another, in the United Kingdom, is "well over" 250,000, and one reason for this conclusion is that full information as to certain classes, *e.g.*, those in receipt of sick pay or old age pay from Friendly Societies, and from pension charities, is not obtainable. Another reason is that the figures take no account of persons receiving pensions and allowances from former private employers, nor of those benefiting under superannuation schemes of business firms or companies. It must not be forgotten that a large section of the persons here referred to are in receipt of pensions, or superannuation allowances, to which they have themselves contributed.

Some reduction in the expenditure on Poor-law relief has usually been assumed, whether as an immediate, or a more remote, result of schemes of old-age pensions. There is a general agreement in the reports of the various committees who have considered the question of old-age pensions, that the cost of indoor relief would be practically unaffected by the operation of a pension scheme. The only appreciable saving in Poor-law expenditure would be in the portion which relates to out-door relief, amounting in 1904-5 to £3,265,000, to which must be added £532,000, the salaries of officers, and minor incidental expenses connected with the administration of out-door relief. The present report does not commit itself to any definite opinion as to what saving might be anticipated, but it is pointed out that in regard to any possible saving some part of the cost of out-door relief consists of medical relief, which is more particularly necessary in the case of the aged, and it is unlikely that the cost to the Poor-law of medical relief would be diminished. And in any saving of Poor-law expenditure, urban and rural unions would be somewhat differently affected. The number of paupers 65 years of age and upwards, in proportion to the total population of the same age, varies greatly in different parts of the country, and the number is usually higher in rural than in urban areas. The report does not discuss the very important question as to how, assuming them to be decided upon, old-age pensions are to be paid, nor does it specifically recommend any particular scheme. The estimated cost of the Chaplin Committee scheme, with its many deductions, has been given above. Assuming a scheme of universal character, the report finds that the total number of persons, aged 65 and upwards in 1907, may be put at 2,116,000, and that the cost of granting a pension of 5s. a week to all persons of this age without distinction would, at the outset, amount for the United Kingdom to £27,508,000, apart from the cost of administration. This amount would be equivalent to a poll-tax of about 12s. 6d. per head on the total estimated population (1907) of the United Kingdom. The cost of pensions granted universally to persons of 70 years and upwards, would amount to £16,302,000, the estimated numbers of that age being 1,254,000. The cost, at a later date, after the scheme had become operative, would be affected only by the natural growth of the aged section of the population, and in 1921 would be, as estimated by the report, £30,632,000 for all persons 65 years and upwards.

INDIAN COFFEE.

The production of coffee in India is restricted for the most part to a limited area in the elevated region above the south-western coast, the coffee lands of Mysore, Coorg, and the Madras districts of Malabar and the Nilgiris, comprising 86 per cent. of the whole area under coffee cultivation throughout the country. There has been a decrease in the estimated area in each year since 1896, and in the three years, 1904-6, both inclusive, there has been a net decrease of 21,564 acres.

But while the area has been steadily diminishing, the exports, which account for the greater part of the crop, rose steadily in the five years ending 1905-6, and were greater in that year than in any year since 1888. In 1906-7, however, unseasonable rains were reported from nearly all the principal coffee-growing districts, and the total quantity exported (25½ million lbs., as against 40⅓ million lbs. in 1905-06) decreased by over one-third.

It is difficult, if not impossible, to arrive at any estimate of the quantity of coffee consumed in India, but it must be considerable, for, in Southern India at all events, there are none but the poorest, who do not drink coffee, and no bazaar so small that coffee is not procurable. There is also a steady export of about two million pounds to Ceylon, indicating a large and regular consumption, which is probably a commensurate indication of the demand among the natives on the western side of Palk's Straits.

The two chief markets for Indian coffee are the United Kingdom and France; but no Indian coffee went direct to the United States, although that country consumes nearly one-half of the total quantity of coffee exported from all the countries of the world.

The total number of persons employed on the coffee estates in 1896 was 70,521, or at the rate of one person to every 2·8 acres.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department, Admiralty, in July, 1907:—

New Charts.—No. 1543—England, east coast:—Yarmouth and Lowestoft roads, Yarmouth haven, Lowestoft harbour. 3656—Baltic:—Giedser Rev and approaches to Nysted. Plan:—Warnemünde Harbour. 3619—British Columbia:—Moresby passage to Gabriola pass, southern sheet. 205—Plans in the Red Sea:—Mersa Fejer, Mersa, Daiúr, Mersa

Kihai. 22—Persian Gulf:— Kuweit harbour and approaches. 3662—Philippine islands. Plans on the north-west coast of Luzon:—Port San Esteban and Nalvo bay; Santiago cove, Darigayos inlet, Solvek cove. 1961—Formosa, west coast:—Pescadores islands. 3652—Korea, west coast:—Amunyoku kan (Yalu river). 3650—Japan, Honshu (Nipon), south coast:—Toba ko. 1175—South Pacific ocean; sketches of anchorages in the Tuamotu or Low archipelago:—Ahii or Peacock island, lagoon entrance; Manihi entrance; Tokea or Takaroa, lagoon entrance; Amyot bay, Avatoru entrance, Tiputa entrance; Mururoa or Osnaburg island; north passage to Rotoava; Fakahina island; passes into Amanu atoll; Pakaka (Aniuru) pass; Pakaka to Seignelay point. 3664—South Pacific ocean; passes and anchorages in Tuamotu or Low archipelago:—Raroia pass and anchorage; Makemo island, north-east pass and anchorages; Tahanea island passes.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.

1859—England, west coast:—King road. 355a—United States, east coast:—Chesapeake bay. 1496—Bahamas:—Great Bahama bank, sheet I. 2077—Bahamas:—Sheet IV., from Exuma to New Providence. 2431—Alaska:—Port Simpson to Cross sound. 2458—Alaska:—Port Simpson to port McArthur. 3252—Central Africa:—Victoria Nyanza, northern portion. 755—Bay of Bengal:—False point anchorage. 1338—Pescadores islands:—Inner anchorages. 1798—China, north coast:—Kwang tung peninsula, &c. 2833—China, north coast:—Port Adams. Hulu shan bay. 997—Japan:—Yokoska harbour. 752—Japan:—Owasi bay to Takamatsu no saki. 3565—New Zealand:—Bream head to Tepaki point. 214—Solomon islands.

These charts are issued by Mr. J. D. Potter, 145, Minories.

PAUPERISM.

The official statement as to the position of pauperism in England and Wales at the end of June, just issued, shows some diminution in the number of paupers relieved, as compared with the same months in preceding years. Not only was the number of persons in receipt of poor relief slightly lower than in 1905, the tendency to decrease was most marked in the later months, the decline in London being greater than in the rest of the country. But the number of paupers is still comparatively high. The rate of pauperism to population stood at 26·7 per 1,000 on the 1st January, 1907. This was a lower rate than in the two previous years, when it was respectively 27·1 and 27·6, but higher than in 1904, when it was 26·0, having been as low as 24·8 in 1901. These per-centages relate to the whole of England and Wales. Taking London alone, the per-centage which was 27·4 in 1901, and had steadily risen until it was 31·7 in 1906, fell to 30·8 in 1907, being still considerably higher than the per-centage for the whole of England and Wales. The general decline of pauperism in England and Wales, in comparison with a number of periods in the not very distant past, is shown in the following figures. The average rate of paupers relieved per 1,000 of population in the quinquennial period 1872-1877, was 35·4; in 1885-1892, 25·6; in 1902-1907, 26·4. While out-door pauperism in 1907 shows in the aggregate a decrease as compared with 1906—15·8 against 16·3—the increase in indoor pauperism which marked the preceding years is maintained. The number of the indoor paupers in London increased by over 100 per cent. between 1872 and 1907—72·370 against 36·175, exclusive of insane and casual paupers. The same class in provincial unions has increased by over 75 per cent. in the same period—176·575 against 100·652—but the rise has been at a noticeable high rate in the last decade than in earlier years. The number of out-door paupers shows a corresponding decline as compared with the indoor poor. The rate of pauperism to population shows a greater increase in London than in provincial unions during the years 1902 to 1905, and the decline in London since the latter date has also been more marked. The total number of persons relieved as lunatics or idiots on the 1st January, 1907, was 110,613, being 12 per cent. of the whole number of persons chargeable to the poor-rate. A larger proportion of the total pauperism in the urban than the rural districts of this class, *e.g.*, in London 17 per cent., Lancaster 14 per cent., York, West Riding, 12 per cent., as compared with 9 per cent. in Norfolk, and 8 per cent. in Suffolk. The average in the numbers of the insane between 1st of January, 1906, and 1st January, 1907, amounted to 1·8 per cent. in England and Wales.

DEVELOPMENTS IN ELECTRIC INCANDESCENT LAMPS.*

The author gave a short description of the latest developments made in the manufacture of incandescent electric lamps, and exhibited, amongst others, samples of graphitised carbon lamp, the Gem, Nernst, Osmium, Tantalum, Osram, Tungsten, Yust and Hannaman's lamps, Kuzel, Zircon-Wolfram (several types), including also a sample lamp called by the inventors (Prof. Parker and Mr. Clark) the "Helion" lamp, and shown for the first time in England. Owing to the high efficiency of these lamps, Mr. Gaster predicted that the expense for electric lighting will be greatly reduced in the near future, and that better illumination will be obtained.

* Abstract of a paper read by Leon Gaster before Section G of the British Association at Leicester.

Some of the lamps shown consume less than one-third of the energy required by the ordinary carbon incandescent lamps, which means enormous saving. The progress made this year was remarkable. Many manufacturers on the Continent are ready to supply large quantities of these new metal filament lamps, and in England the Robertson Lamp Manufacturers are extending their works with a view of making these lamps here. The "Z" Electric Lamp Syndicate are about to manufacture the filaments to be used in the "Zircon Wolfram" lamp in this country. Mr. Gaster pointed out the desirability of lamp makers supplying lamps combined with suitable shades and reflectors in one unit so as to assist consumers in obtaining any desired effect of illumination, either by concentration or diffusion. Particular attention was drawn to the need for manufacturers and large consumers of light to adopt proper methods of illumination, the advantages of this being many, viz.: First, the sight of the people will be improved and prolonged; secondly, the output will be quite appreciably increased; and thirdly, the quality of the work done under proper illumination will be of the same standard as when done in the day-time. The economies derived by not using proper methods of illumination are false economies, when one bears in mind the fact that the expense of providing and keeping up proper illumination is in most cases only a small fraction compared with the value and the nature of the work turned out. This question of defining the proper amount of light necessary for different purposes will form the work of the illuminating engineer. For the creation of this new specialist the author is a strong advocate.

Reference was made to the useful work for improving the quality of incandescent lamps, and towards helping the consumers in obtaining more satisfactory illumination done by the Engineering Department of the National Electric Lamp Association, and by the Electric Testing Laboratories of New York.

OPENINGS FOR FARMING IMPLEMENTS IN MANCHURIA.

Manchuria is expected within a short time to be a good market for nearly all kinds of modern agricultural machinery and appliances, as the northern part of the country is very fertile, and embodies exceedingly large tracts of as rich agricultural land as can be found in any part of the world. This land up to the present time has only been cultivated in the old crude Chinese way, and there are many large areas which are still in a virgin condition. Settlers are flocking in from other and more densely-populated parts of China, but until modern implements are introduced to the farmers' notice, by samples and practical demonstration of their utility, the old conditions will doubtless continue to prevail. The American Consul at Newchwang says that as the land in the vicinity of that place is marshy and practically unfit for farming purposes, it would be difficult for the merchants there to get into touch with the farmers, even if samples of agricultural machinery were available. For that reason it would not pay the machinery merchant to take the matter up on his own account, as to do so he would be obliged to take the samples some hundreds of miles up country, and give practical demonstrations, which would only be possible by obtaining a special expert for the purpose. The northern Chinese are firm believers in a "chop"—that is, if they adopt or get into the way of using a certain brand of anything, and if it suits their purpose, they will continue to use that particular chop or brand, so long as they can get it, in preference to any other, and it is difficult to get them to change, even to an improved article, for they know what the article they have used can do, and are sure that it will satisfy their requirements, while with any other chop or brand there is an element of uncertainty, and they prefer to be sure rather than to run any risk of being sorry later on. This makes it obvious that the manufacturers who first get their goods will reap the greatest benefit, and have very litttle trouble in holding the trade thereafter. The port of Newchwang has greater advantages for supplying the Manchurian market than any other, the main competitors being Vladivostock and Dalney. The former is dominated by Russians, who are not to be greatly feared owing to their having to transport their supplies long distances by railway; the latter place is controlled by the Japanese, who are ambitious, enterprising, and are losing no opportunity to secure for themselves the trade of Manchuria; but they are also at a disadvantage in being obliged to depend on their railways for the transportation of everything into the interior, while Newchwang has the advantage of being able to reach a large section of the country by Chinese junks which ply on the river Liao and its tributaries for eight months in the year and deliver freight at much lower rates than the railways can possibly do. Manchuria has been greatly handicapped for the past fifteen years by political troubles, which seriously retarded the progress and development of the country; but now the political horizon is clearing, and the inhabitants are turning their attention to farming and other industrial pursuits with renewed zeal, which will undoubtedly lead to a greater prosperity than was ever known before; and especially with the influx of new settlers, the country has great possibilities in both farming and mining, and it is believed that within a very few years, it will be one of the best markets for agricultural machinery and farming implements in all Asia. Whether the demand will be supplied by America or Europe will depend entirely upon the enterprise shown by the manufacturers themselves, for as already intimated those who first get their goods introduced will be hard to depose, even though others may offer superior goods.

ARTS AND CRAFTS.

Industrial Art in Sweden.—In the intervals between the great international exhibitions, though we have from time to time opportunities of looking at what is being produced in France and Germany, we see very little of the productions of the smaller European nations. Their wares are largely made for home consumption, and of those which go abroad, more find their market in the United States than in Great Britain. Meanwhile these countries are not by any means standing still; they are in some ways far more keenly interested in art movements than we are ourselves, and far more eager to be in the front rank in matters connected with industrial art. If we look at what is being done in Sweden at the present day, we see that, in spite of an intensely strong national feeling, the work turned out in the other countries of Europe has not only been keenly watched, but closely studied, and, in some cases, imitated. There is the same desire to be up to date; the same continual struggle to be original at all costs which characterises so much of the work nearer home.

Two very powerful and in many respects quite opposing influences are apparent in modern Swedish industrial art—the modern spirit and the national and patriotic feeling. Swedish painters have, for the most part, studied in Paris, and have brought back with them modern ideas and notions in abundance, and in Sweden it is not uncommon for artists who have achieved some measure of success in pictorial work to turn their attention either to decoration or to applied art. On the other hand, there has arisen of recent years a very strong movement (the force of which seems to have been very greatly increased by the rupture with Norway) in favour of retaining, encouraging, and reviving the old national and traditional forms of design—more especially in weaving, embroidery, and jewellery. Of course, the two movements have not been altogether in the same sphere—that towards modernity has been current mainly in architecture, decoration, and design for manufacture, while the stronghold of the traditional and patriotic movement has been in the more simple crafts which we should call "Home arts and industries." Still there come points where the two meet, and the result, though not always satisfactory, is at least interesting. It leads in design to something which without being exactly affected is rather mannered, and it must be admitted that at times it goes very near to incoherence.

Swedish Furniture.—Mnch of the modern Swedish furniture is frankly on the lines of that being made in England and France, some of it, following the taste which seems to be rather fashionable just now all over Europe, is a kind of Swedish imitation of the Empire period, and is interesting from the fact that it is, as it were, individual in spite of itself. While the would-be original work is quite often commonplace, it happens by the irony of fate that what is meant to be a copy has, as a rule, some real claim to individuality. In a country so well wooded as Sweden it is only natural that workers in wood should have developed certain little tricks of workmanship which are characteristically their own. These characteristic touches are, however, naturally enough, still more noticeable in the modern versions of the old peasant furniture which are now, thanks in part to work of the *Svensk Hemslöjd* very often to be seen. There is, indeed, in some quarters quite a fashion for this old Swedish peasant furniture, roughly made and painted (generally in blue or green), with perhaps some slight carving about it and completed by additional painted ornament of what is meant to be a naturalistic kind. Deliberately rude cupboards, tables, and chairs of this description hardly look out of place even in quite modern conntry houses in Sweden, and they have a certain charm of their own. It is only when they are surrounded by the luxury usually associated with a large town that they seem out of keeping.

The still more simple carpenter's work is very often most ingenious. Slightly carved garden benches are habitually made with backs which can be turned in either direction, on the plan of the seats of a London electric tram-car; there are also various forms of simple shelves and cupboards being made, as well as pieces of furniture designed to serve as either tables or chairs, which would be well worth imitating by people interested in home arts in our own country. The work is often primitive enough, but it is of the kind which should be within the power of most carpentry classes, and, in its simple way, it is both effective and pleasing.

Swedish Embroidery and Embroidery and Hand-loom Weaving, &c.—We are proud in England of the revival which has taken place in embroidery, hand-loom weaving, lace making, and textile handwork generally. It is, therefore, rather a shock to find the same movement even more fully organised in Sweden than it is with us.

As regards very fine embroidery and gold thread work there is, of course, little in Sweden to compare with what is being done at home, though, following the tradition of the country, they still make very excellent use of inlay where we should content ourselves with appliqué.

Swedish lace, though interesting as the survival and revival of a traditional industry, is not in itself ordinarily very beautiful or very fine in workmanship.

In the coarser kinds of embroidery, however, a good deal of interesting work is being done, and that too not only by individual workers, but in big shops and ateliers, and on a surprisingly large scale.

Not only, as with us, are artists of repute willing to make designs for embroidery, but the larger societies and institutions, such as *Handarbetets Vänner* and the textile department of *Nordiska Companiet*, employ quite a number of designers—some of whom are attached to one particular society, while others work independently. It does not appear to be the

fashion to encourage the workers to make their own designs.

Of the patterns, both for weaving and embroidery, a large number are of a traditionally Swedish character owing, perhaps, rather more to patriotic feeling than to any desire to imitate what is old. Indeed, those designs which are not on old lines are generally very modern in feeling. The methods of workmanship, and even the colours employed are, in the main, the old ones.

Perhaps the most interesting kinds of work from an English point of view are the appliqué embroidery, and the kind of woven fabric which is called in Sweden *Flossa*. They are both developments of peasant work. Much of the embroidery, and especially the appliqué, is done on felt or cloth; and most effective work is produced by appliqué of different coloured cloth, sometimes couched, sometimes stitched, sometimes just run, on to a cloth ground. There is a great deal more variety of colour in this simple, rather barbaric, Swedish appliqué than in any work of the kind done in England. It is rather odd that, in opposition to this, some of the best fine work is in white silk on a white or unbleached ground. The design, however, of much of this white embroidery, which is at first sight almost Oriental looking, proves on examination to be in the manner of old Swedish work. In the *Flossa*, which is woven in a hand loom, the pattern is raised, and is formed by different coloured threads, worked into the warp and left upstanding in loops (like terry), which are afterwards cut, and give the effect of a pattern in pile on a ground of woollen material. The fabric is very effective, and eminently suitable for chair-backs and small covers or rugs.

The patterns used in the ordinary hand-loom weaving are rather different from those most in favour in England, and very great use is made of the chequer, which proves to be the basis of many designs, in which, at first sight, it hardly seems to occur at all. A good deal of tapestry weaving is also being done, but it seems unlikely that there can be any great demand for work of this kind at a price which would make it worth while to produce it. There appears to be a certain amount of energy wasted in encouraging crafts which are, after all, remains of a bygone condition of life—one might almost say of a past age of civilisation. But it must be remembered that in Sweden, in some of the country districts at least, "home arts" are not things of the past which have to be or less laboriously revived, but existing occupations of the peasant folk more or less in danger of being ousted from their place by the competition of machine-made goods. It may be, and probably is, quite good policy to encourage the country to weave for themselves the things which they use, to teach them in so doing to choose what is artistically good instead of bad, and may be to help them to dispose of any goods which they may be able to make over and above what they need for their own homes. But how far it is wise to encourage tapestry weaving and other industries, by means of which are produced, with great labour, effects not unlike those which could be (though they often are not) obtained in machine-made fabrics, is much more uncertain. Such work is just now more or less the fashion. Whether there will continue to be a sale for it at a price which will enable the workwoman to earn a living is an open question, and one which, in the light of the impetus being given to such work at the moment, demands rather serious consideration.

CORRESPONDENCE.

EFFECT OF IRRIGATION ON ALKALI SOILS.

I was glad to see Mr. Wright's letter on the above subject in the *Journal* for August 16th, and a profitable discussion would ensue if gentlemen with expert knowledge of practical experience in the matter, not only in India but in other countries where irrigation on a large scale is practised, could be induced to state their views. So far as the great irrigation colonies in India are concerned there is no immediate danger of serious damage due to the deterioration of alkali soils under irrigation, but there appears to be considerable diversity of opinion as to the proper methods to employ in the application of irrigation to alkali soils so as to minimise the danger of bringing the salts to the surface in excessive quantities and so spoiling the land for cultivation. And as it is the case that individual colonists have suffered considerable loss in places owing to unsuitable treatment of their allotments, a comprehensive inquiry into the subject conducted by a qualified agricultural engineer should be productive of good results. L. ROBERTSON.

Swanbister, By Kirkwall, Orkney,
22nd August, 1907.

NOTES ON BOOKS.

EMBROIDERY AND TAPESTRY WEAVING. By Mrs. A. H. Christie. The Artistic Craft Series of Technical Handbooks. London: John Hogg.

This is a very workmanlike little book. The author knows her subject, and sets to work to tell what she knows with as little padding as possible. After a short preface and introduction, one chapter on tools and another on pattern designing (which, by the way, contain between them more controversial matter than all the rest of the book put together), she proceeds to describe at length, with the help of adequate diagrams, the various stitches and methods of work, and concludes the embroidery section of her book with chapters on "the garniture of work" and "practical directions."

Readers have learned to expect that in serious books on embroidery the stitches will be methodically and carefully grouped, and our hopes, on the whole, prove to be well founded in this volume—though it is rather difficult to see why two such radically different sets of stitches, as satin-stitch and buttonhole, should have been grouped together to form a chapter.

Mrs. Christie's sympathies would appear to be rather with fairly bold work executed in the hand than with very fine embroidery done in a frame—and she devotes a good deal more space to describing the various chain-buttonhole, knot, herring-bone, and other fancy-work stitches—which have been adequately explained before by other writers, than to giving directions for the production of good effects in satin-stitch or couching - though she has not neglected this part of her task. The sections which treat of drawn threadwork, cut and open work, darning on net, open work fillings, quilting, &c., help to make the book more complete than most volumes on embroidery.

There are admirable hints on how best to use the stitches described, and a much-needed chapter on garnitures; but it is somewhat of a surprise to be told that "even more than simpler work applied embroidery needs the work of some light finish upon the ground."

Mrs. Christie's studies seem to have led her mainly in the direction of English work. She tells about English knotted line work in which "the knotting was executed in the thread previously to embroidering with it," but she makes no mention of the frequent occurence of this little fraud in Chinese work. Her description of the stitch employed for the famous Syon Cope is thorough, and she seems to look upon the use of some such method as quite within the range of practical present-day politics.

Tapestry weaving is far less fully treated than embroidery, occupying only about fifty pages out of over three hundred and fifty. The directions given for setting up the loom and starting work, as well as for executing small pieces of work in an ordinary embroidery frame, are thoroughly clear and practical. The necessary tools and materials are carefully described, and the difficulties and limitations of the craft are sufficiently indicated.

The volume is well illustrated. Of the 16 collotype plates, many might with advantage be on a larger scale – these are not, however, the most important part of the illustrations. The description of the stitches, methods of work, &c., are liberally supplemented by diagrams in the text, drawn by the author herself, and these are so clear and so practical, that in many cases it is an easy matter to see exactly how a stitch is worked without referring to the text at all.

THE TOURIST'S INDIA. By Eustace Reynolds-Ball. London: Sonnenschein and Co. 1907.

The author has produced a well illustrated volume, which he claims to be not a guide-book, but a popular sketch of the present-day topographical, archæological, historical, and social aspects of the great show cities and tourist centres of India. At the same time, he is careful not to assume a very profound knowledge of India and Indian affairs on the part of tourists and others.

Wintering in India, owing largely to improved conditions of travel, has become increasingly popular, but the tourist is warned that he must not compare India with Egypt, except to the disadvantage of the former as a health resort owing to the fluctuations of temperature. "For real invalids, India is altogether unsuited; semi or quasi-invalids, with due precautions as to locality, regimen, &c., will probably benefit by a winter sojourn; while ordinary travellers, provided they follow a few common-sense rules about diet and clothing, will derive much pleasure and profit from a winter in India." The Indian Government, with a view of encouraging tourist traffic, grant specially reduced rates for certain specified circular tours, thus the tourist may visit Calcutta, Benares, Lucknow, Cawnpore, Delhi, Agra, Jhansi, Gwalior, and back to Calcutta, *vià* Cawnpore and Allahabad, at the low first-class fare of ten pounds fourteen shillings. The total cost of this flying visit, including second-class fare (P. and O.) London to Calcutta, is worked out at £100.

Some practical information is given in the appendix, and a clear map of the Indian Empire is added.

WRITING, AND ILLUMINATING, AND LETTERING. By Edward Johnston (with Diagrams and Illustrations by the Author and Noel Rooke). London: John Hogg. (Artistic Craft Series of Technical Handbooks.)

The increased interest in writing, illuminating, and lettering, at the present day explains the very remarkable development of one of the minor arts. There is a considerable number of old books on penmanship, but most of these books are too full of flourishes, intended to glorify the writing-master rather than to make pleasant-reading manuscripts. The chief object of the new movement is legibility combined with beauty. One effect of the revival of interest in beautiful handwriting is the production of manuscript books, a movement in which the late William Morris was a leader.

Mr. Lethaby, the general editor of the series, remarks: "Of all the arts writing, perhaps, shows most clearly the formative force of the instrument used. In the analysis which Mr. Johnston gives us in this volume nearly all seems to be explained by the two factors – utility and masterly use of tools. No one has ever invented a form of script, and herein lies the wonderful interest of the subject; the forms used have always formed themselves by a continuous process of development."

The author writes: — "Generally, this book has been planned as a sort of 'guide' to models and methods for letter craftsmen and students, more particularly for those who cannot see the actual

processes of writing, illuminating, &c., carried out, and who may not have access to collections of MSS."

The effect of carrying out this scheme has been the production of a fully-illustrated book, with minute instructions as to tools and examples which ought to be of the greatest value to those who wish for full information on this fascinating subject. Handwriting is a subject that has been too long neglected; now it has been taken up by enthusiastic teachers. Mr. Johnson well says:—"The Roman alphabet is the foundation of all our alphabets, and since the full development of their monumental forms about 2,000 years ago the Roman capitals have held the supreme place among letters for readableness and beauty. They are the best forms for the grandest and most important inscriptions." Nowhere is there a finer presentation of Roman capitals than is to be seen in the inscription on the base of the Trajan column at Rome (A.D. 114).

It will be remembered that Mr. Johnston read a paper on "Calligraphy and Illumination" before the Applied Art Section of the Society on January 31st, 1905.

THE CAUSES OF DECAY IN A BRITISH INDUSTRY. By "Artifex" and "Opifex." London: Longmans, Green, and Co. 1907.

In this work the authors set forth in considerable detail their views of the decay of the great Birmingham gun trade. The titles of the different chapters give an idea of the object of this book: Making an Industry; Decline of the British Industry; Some Causes of the Decay; Economic Production; Home Legislation affecting Production; Home Legislation affecting Trade with the United Kingdom; Home Legislation affecting the Export of British Manufactures; Indian and Colonial Legislation affecting Imports of British Goods; British and Foreign Trade with Foreign Countries; American Trade and Industry; Governments in Business. The authors claim to show "from records other than the Board of Trade Returns, how the industry was established, how it grew and thrived in Great Britain. For nearly half a century there are records of the annual output from the Birmingham district, and from these and a mass of independent collateral evidence, the authors prove beyond a doubt that the industry is declining in Great Britain. They are able to show also that the world's annual output is actually increasing."

GENERAL NOTES.

BRITISH INSURANCE COMPANIES IN URUGUAY.—More than two-thirds of the total fire insurance in Uruguay is transacted with British companies, whose premium incomes may be roughly estimated at sums ranging from £25,000 to £2,000,000. Referring to this subject in his report on the trade of Uruguay for 1906, Mr. R. J. Kennedy, His Britannic Majesty's Minister at Monte Video, says (Cd. 3283-116) that as regards fire companies the British offices have an overwhelming majority, no less than 18 of the best-known British offices being represented at Monte Video against three French, three German, and three Argentine companies. In maritime insurance, too, the British are in a majority there, three British companies occupying the field as against one German, and one Italian firm. As regards life insurance there is comparatively little business as yet done in Uruguay. The actual figures which would show the proportionate premium incomes are not available, but the competition for healthy business is keen, and there are few desirable fire and marine risks which are not covered by insurance. On the other hand, Mr. Kennedy is informed that there are in Uruguay not more than 2,500 life policies in force, the country having about 1,000,000 inhabitants. The public have not yet been "educated up" to the advantages of life insurance. Even when a life policy is taken out it is usually an endowment policy. "El que verga atras que arregle," a Uruguayan saying equivalent to "Après moi l'deluge," is typical of the feelings of most inhabitants of Uruguay towards life insurance. The taxes levied upon life insurance companies are an annual license of £42 upon native and of £84 upon foreign companies. There is also a tax of 2 per cent. upon the premiums of insurance done by native fire and marine companies, and of 4 per cent. upon foreign companies. Life insurance companies pay ½ per cent. in the case of native and 2 per cent. if foreign, calculated upon a similar basis.

ROYAL SANITARY INSTITUTE.—The 44th course of lectures and demonstrations for Sanitary Officers will be given in September-November, 1907. The course comprises the following lectures:—Part I.—Four lectures on Elementary Physics and Chemistry in relation to Water, Soil, Air, and Ventilation, and Meteorology. Twenty-one lectures on Public Health Statutes; Orders, Memoranda, and Model By-Laws of the Local Government Board and the By-Laws in force in the Administrative County of London. The Practical Duties of a Sanitary Inspector, *e.g.*, drawing up notices as to Sanitary Defects, Drain-Testing, Disinfection, Methods of Inspection, Note-taking, Reporting, and Elementary Statistics. Municipal Hygiene or Hygiene of Communities, including Prevention and Abatement of Nuisances, Sanitary Defects in and about Buildings and their Remedies, Water Supplies, Sanitary Appliances, Drainage, Refuse Removal and Disposal, Offensive Trades, Disinfection. Building Construction in its Sanitary Relations, Local and Physical Conditions. Measurement and Drawing Plans to Scale. Inspections and demonstrations are arranged in connection with the lectures. Part II.—Seven lectures on Meat and Food Inspection, including Taking of Samples of Water, Food, and Drugs for Analysis. Practical Demonstrations of meat inspection are given.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The Results of the Elementary Examinations (Stage I.) have been issued, and copies have been sent to all Examination Centres for distribution to candidates. The Examination Programme for 1908 will be ready in about a fortnight.

STOCK PRIZE.

FOR THE DECORATION OF PART OF THE INTERIOR OF A BUILDING.

The Council of the Society of Arts are prepared to offer, under the terms of the Stock Trust, a Gold Medal, or a Prize of £20, for competition amongst the students of the Schools of Art of the United Kingdom, at the Annual Competition to be held in 1908.

The Prize is offered for the best original designs for an Architectural Decoration, to be carried out in painting, stucco, carving, mosaic, or any other process.

This Architectural Decoration is to be for the side of a room or a hall, a ceiling, the apse or side of the chancel of a church, or any suitable part of the interior of a building.

The designs must be on imperial sheets. Each set must consist at least of a coloured drawing to scale of the whole design of decoration, and two coloured drawings of details on separate imperial sheets. Mere patterns or sketches of details, without the mouldings or borders necessary to make up a complete decorative scheme, will not be taken into consideration. The designs must have been made between 1st April, 1907, and 31st March, 1908.

The recipient of a prize awarded under this trust in 1893 or 1897 cannot compete again.

The designs are to be submitted, with other school work, in the usual manner, to the Board of Education, South Kensington, in April, 1908. Each of the imperial sheets, forming a set of competing designs, must be marked, "In competition for the Stock Prize," in addition to being labelled or staged according to the Regulations of the Board of Education.

SECTIONAL COMMITTEES.

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The following is the list of the Colonial Section Committee, as appointed by the Council:—

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Hon. W. Pember Reeves, High Commissioner for New Zealand.
Viscount Ridley.
Right Hon. Sir Joseph West Ridgeway, G.C.M.G., K.C.B., K.C.S.I.
Alexander Siemens.
Sir John Smalman Smith, M.A.
Hon. Sir Richard Solomon, K.C.B., K.C.M.G., K.C., Agent General for the Transvaal.
Earl of Stamford.
Lord Strathcona and Mount Royal, G.C.M.G., LL.D., High Commissioner for the Dominion of Canada.
Sir Thomas Sutherland, K.C.M.G.
Hon. J. W. Taverner, Agent-General for Victoria.
Carmichael Thomas.
Hon. Sir Horace Tozer, K.C.M.G., Agent-General for Queensland
Sir William Wood Treacher, K.C.M.G.
Sir Charles Rivers Wilson, G.C.M.G., C.B.
Sir J. Wolfe-Barry, K.C.B., F.R.S.
Sir Frederick Young, K.C.M.G.
S. Digby, C.I.E. (Secretary).

MINES OF THE WORLD.

The fourth part of the Home Office Report on Mines and Quarries for 1905 containing Colonial and foreign statistics has lately been published.

The particulars are compiled from various official and unofficial sources. Great difficulties in preparing this part of the volume arise either from want of adequate official statistics or from the lateness of their publication. In several cases the statistics for 1905 were not received until the present year was far advanced.

The general results are summed up (1907), and though the figures are not complete, they are sufficient to give a fair general idea of the relative importance of mining in each country.

According to Table 284 the number of persons engaged in mining and quarrying at home and abroad in 1905 exceeded five millions. Of this total, roughly speaking, nearly one-fifth were employed in the United Kingdom and more than one-third in the British Empire. It should be noted, however, that no statistics are published by several countries, *e.g.*, Bolivia, Brazil, China, Persia, Roumania and Turkey, in which mining is carried on, or for the ore mines and quarries of the United States, and the figure in this Table probably falls considerably short of the real total.

More than half of the total number were employed in getting coal alone, Great Britain employing over 843,000, the United States 626,000, Germany 548,000, France 175,000, Belgium 135,000, Austria 119,000, and India nearly 90,000.

Table 285 summarises the world's output of the most important minerals in 1905. The total amount of coal produced was 941 million tons, the value of which is estimated at more than 305 million pounds sterling. The quantity and value compared with 1904 show an increase of more than 55 million tons and 10 million pounds sterling respectively.

The following figures show the main sources from which the fuel supply of the world is obtained: —

Country.	Quantity.		Value.	
	Metric Tons.	Increase or Decrease on 1904.	£	Increase or Decrease on 1904.
		Metric Tons.		£
United States	356,454,000	+ 37,258,000	97,897,000	+ 6,650,000
Great Britain	230,918,000	+ 3,760,000	82,030,000	− 1,813,000
Germany	173,811,000	+ 4,360,000	58,611,000	+ 1,313,000
Austria-Hungary	42,454,000	+ 1,923,000	10,462,000	+ 387,000
France...	35,928,000	+ 1,760,000	18,562,000	+ 385,000
Belgium	21,775,000	− 986,000	11,007,000	− 459,000

Gold shows an increase of 63,960 kilograms, the total output being 580,087 kilograms (18,650,217 ozs.) of which the value is estimated at over 79 millions sterling. The British Empire supplied nearly 59 per cent. of the output; Australia contributing 19½ per cent., the Transvaal 26⅓ per cent., and Canada 3¼ per cent. of the total. The United States contributed 22¾ per cent.

In the case of iron, the United States, with an output of 23⅓ million tons, is considerably ahead of any other country. The German Empire, with 6 million tons, and Great Britain, with about 4¾ million tons, come next. It is important to point out that the quantities of the other metals included in this Table are those which are considered otainable from the ores raised in the countries in question, and must not necessarily be taken as a measure of their metallurgical industries.

The value of the world's output of copper is about equal to the combined value of the outputs of silver, tin, and zinc. The total value of the figures shown in the Table giving a summary of output of minerals and metals may be roughly taken as representing over 700 millions sterling.

The next Table shows the loss of life from accidents in mines and quarries, and the death-rates from accidents per 1,000 persons employed. Taking coal mines, for which the figures are fairly complete, it will be seen that the death-rate of the United Kingdom is 1·35, and for the British Empire 1·34; while for France it is 1·04, for Germany 2·05, and for the United States 3·45. The death-rate for foreign countries generally is 2·40.

In the case of gold mines, complete figures are only available for the British Empire. They show a considerable increase in the death-rate from 2·55 in 1904 to 3·58 in 1905.

HISTORY OF THE DEVELOPMENT OF ELECTRIC MOTIVE POWER.*

There is one last example of the interaction of science and industry which may claim closer attention. In the history of the development of the electric motor one finds abundant illustration of both aspects of that interaction.

We go back to the year 1821, when Faraday, after studying the phenomena of electromagnetic deflexion of a needle by an electric current (Oersted's discovery), first succeeded in producing continuous rotations by electromagnetic means. In his simple apparatus a piece of suspended copper wire carrying a current from a small battery, and dipping at its lower end into a cup of mercury, rotated continuously around the pole of a short bar-magnet of steel placed upright in the cup. In another variety of this experiment the magnet rotated around the central wire, which was fixed. These pieces of apparatus were the merest toys, incapable of doing any useful work; nevertheless they demonstrated the essential principle, and suggested further possibilities.

Two years later, Barlow, using a star-wheel of copper, pivoted so that the lowest point of the star should make contact with a small pool of mercury, found that the star-wheel rotated if a current was sent through the arm of the star, while the arm itself was situated between the poles of a steel horseshoe-magnet. Shortly afterwards Sturgeon improved the apparatus by substituting a copper disc for the star-wheel. The action was the same. A conductor, carrying an electric current, if placed in a magnetic field, is found to experience a mechanical drag, which is neither an attraction nor a repulsion, but a lateral force tending to move it at right angles in the direction of flow of the current and at right angles to the direction of the lines of the magnetic field in which it is situated. Still this was a toy.

Two years later came the announcement by Sturgeon of the invention of the soft-iron electromagnet, one of the most momentous of all inventions, since upon it practically the whole of the constructive part of electrical engineering is based. For the first time mankind was furnished with a magnet the attractive power of which could be increased absolutely indefinitely by the mere expenditure of sufficient capital upon the iron core and its surrounding copper coils, and the provision of a sufficiently powerful source of electric current to excite the magnetisation. Furthermore the magnet was under control, and could be made to attract or to cease to attract at will by merely switching the current on or off; and, lastly, this could be accomplished from a distance, even from great distances away. How slowly the importance of this discovery was recognised is now a matter for astonishment. To state that Sturgeon died in poverty twenty-six years later is sufficient to indicate his place among the unrequited pioneers of whom the world is not worthy. Six years elapsed, and then there came a flood of suggestions of electric motors in which was applied the principle of intermittent attraction by an electromagnet. Henry in 1831, and Dal Negro in 1832 produced see-saw mechanisms so operated. Ritchie in 1833 and Jacobi in 1834 devised rotatory motors. Ritchie pivoted a rapidly commutated electromagnet between the poles of a permanent magnet—a true type of the modern motor—while Jacobi caused two multipolar electromagnets, one fixed, one movable, to put a shaft into rotation and propel a boat. A perplexing diminution of the current of the battery whenever the motor was running caused Jacobi to investigate mathematically the theory of its action. In a masterly memoir he laid down a few years later the theory of electric motive power. But in the intervening period, in 1831, Faraday made the cardinal discovery of the mechanical generation of electric currents by magneto-electric induction, the fundamental principle of the dynamo. Down to that date the only known way—save for the feeble currents of thermopiles—to generate electric currents had been the pile of Volta, or one of the forms of battery which had been evolved from it. Now, by Faraday's discovery, the world had become possessed of a new source. And yet again, strange as it may seem, years elapsed before the world – that is, the world of engineers – discovered that an important discovery had been made. Not till some thirty years later were any magneto-electric machines made of a sufficient size to be of practical service even in telegraphy, and none were built of a sufficient power to furnish a single electric light until about the year 1857. In the meantime in America other electric motors, to be driven by batteries, had been devised by Devonport and by Page; the latter's machine had an iron plunger to be sucked by electromagnetic attraction into a hollow coil of copper wire, thereby driving a shaft and flywheel through the intermediate action of a connecting-rod and crank. Page's was, in fact, an electric engine, with 2-foot stroke, single-acting, of between 3 and 4 horse-power. The battery occupied about 3 cubic feet, and consumed, according to Page, 3 lb. of zinc per horse-power per day. This must have been an under-estimate; for if Daniell's cells were used the minimum consumption for a motor of 100 per cent. efficiency is known to be about 2 lb. of zinc per horse-power per hour.

Electric Motive Power Impossible in 1857.

Upon the state of development of electric motors fifty years ago information may be gleaned from an exceedingly interesting debate at the Institution of Civil Engineers upon a paper read April 21st, 1857, "On Electromagnetism as a Motive Power," by

* Extract from the Address of Professor Sylvanus Thompson, D.Sc., F.R.S., to the Engineering Section of the British Association at Leicester.

Mr. Robert Hunt, F.R.S. In this paper the author states that, though long-enduring thought has been brought to bear upon the subject, and large sums of money have been expended on the construction of machines, "yet there does not appear to be any nearer approach to a satisfactory result than there was thirty years ago.". After explaining the elementary principles of electro-magnetism, he describes the early motors of Dal Negro, Jacobi, Davenport, Davidson, Page, and others. Reviewing these and their non-success as commercial machines, he says :—"Notwithstanding these numerous trials . . . . it does not appear that any satisfactory explanation has ever been given of the causes which have led to the abandonment of the idea of employing electricity as a motive power. It is mainly with the view of directing attention to these causes that the present communication has been written." He admits that electromagnets may be constructed to give any desired lifting power; but he finds that the attractive force on the iron keeper of a magnet of his own, which held 220 lbs. when in contact, fell to 36 lbs. when the distance apart was only one-fiftieth of an inch. To this rapid falling off of force, and to the hardening action on the iron of the repeated vibrations due to the mechanical concussion of the keeper, he attributed the small power of the apparatus. Also he remarked upon the diminution of the current which is observed to flow from the battery when the motor was running (which Jacobi had, in his memoir on the theory, traced to a counter electromotive force generated in the motor itself), and which reduced the efficiency of the machine. "All electromagnetic arrangements," he says, "suffer from the cause named, a reduction of the mechanical value of the prime mover, in a manner which has no resemblance to any of the effects due to heat regarded as a motive power." Proceeding to discuss the batteries, he remarked that as animal power depends on food, and steam power on coal, so electric power depends on the amount of zinc consumed; in support of which proposition he cited the experiments of Joule. He gives as his own results that for every grain of zinc consumed in the battery his motor performed a duty equivalent to lifting 86 lbs. 1 foot high. Joule and Scoresby, using Daniell's cells, had found the duty to be equivalent to raising 80 lbs. 1 foot high, being about half the theoretical maximum duty for a grain of zinc. In the Cornish engine, doing its best duty, 1 grain of coal was equivalent to a duty of raising 143 lbs. 1 foot high. He put the price of zinc at £35 per ton as compared with coal at less than £1 per ton, which makes the cost of power produced by an electric motor—if computed by the consumption of zinc in a battery—about sixty times as great as that of an equal power produced by a steam-engine consuming coal. He concludes that "it would be far more economical to burn zinc under a boiler and to use it for generating steam power than to consume zinc in a battery for generating electromagnetical power."

In the discussion which followed, several men of distinction took part. Professor William Thomson, of Glasgow (Lord Kelvin), wrote, referring to the results of Joule and Scoresby: "These facts were of the highest importance in estimating the applicability of electromagnetism, as a motive power, in practice; and, indeed, the researches alluded to rendered the theory of the duty of electromagnetic engines as complete as that of the duty of waterwheels was generally admitted to be. Among other conclusions which might be drawn from these experiments was this: that, until some mode of producing electricity as many times cheaper than that of an ordinary galvanic battery as coal was cheaper than zinc, electromagnetic engines could not supersede the steam-engine." Mr. W. R. Grove (Lord Justice Sir William Grove) remarked that a practical application of the science appeared to be still distant. The great desideratum, in his opinion, was not so much improvement in the machine as in the prime mover, the battery, which was the source of power. At present the only available use for this power must be confined to special purposes where the danger of steam and the creation of vapour were sought to be avoided, or where economy of space was a great consideration. Professor Tyndall agreed with the last speaker, but suggested that there might be some way of mitigating the apparent diminution of power due to the induction of opposing electromotive forces in the machine itself. Mr. C. Cowper spoke of some experiments, made by himself and Mr. E. A. Cowper, showing the advantage gained by properly laminating the iron cores used in the motor. He put the cost of electric power at £4 per horse-power per hour. He deprecated building electric motors with reciprocating movements and cranks; described the use of silver commutators; and mentioned the need of adjusting the lead given to the contacts. There was, he said, no reason to suppose that electric motors could be made as light as steam-engines. Even in the case of small motors of one-tenth or one-hundredth of a horse-power, for light work, where the cost of power was of small consequence, a boy or a man turning a winch would probably furnish power at a cheaper rate. Mr. Alfred Smee agreed that the cost would be enormous for heavy work. Although motive power could not at present be produced at the same expense on a large scale by the battery as by coal, still they were enabled readily to apply the power at any distance from its source; the telegraph might be regarded as an application of motive power transmitted by electricity. Mr. G. P. Bidder considered that there had been a lamentable waste of ingenuity in attempting to bring electromagnetism into use on a large scale. Mr. Joule wrote to say that it was to be regretted that in France the delusion as to the possibility of electromagnetic engines superseding steam still prevailed. He pointed out, as a result of his calorimeter experiments, that if it were possible so to make the electric engine work as to

reduce the amount to a small fraction of the strength which it had when the engine was standing still, nearly the whole of the heat (energy) due to the chemical action of the battery might be evolved as work. The less the heat evolved, as heat, in the battery, the more perfect the economy of the engine. It was the lower intensity of chemical action of zinc as compared with carbon, and the relative cost of zinc and coal, which decided so completely in favour of the steam-engine. Mr. Hunt, replying to the speakers in the discussion, said that his endeavour had been to show that the impossibility of employing electromagnetism as a motive power lay with the present voltaic battery. Before a steam-engine could be considered, the boiler and furnace must be considered. So, likewise, must the battery if electric power were to become economical. Then the President, Mr. Robert Stephenson, wound up the discussion by remarking that there could be no doubt that the application of voltaic electricity, in whatever shape it might be developed, was entirely out of the question, commercially speaking. The mechanical application seemed to involve almost insuperable difficulties. The force exhibited by electromagnetism, though very great, extended through so small a space as to be practically useless. A powerful magnet might be compared to a steam-engine with an enormous piston, but with exceedingly short stroke; an arrangement well known to be very undesirable.

In short, the most eminent engineers in 1857 one and all condemned the idea of electric motive power as unpractical and commercially impossible. Even Faraday, in his lecture on "Mental Education" in 1854, had set down the magneto-elecric engine along with mesmerism, homœopathy, odylism, the caloric engine, the electric light, the sympathetic compass, and perpetual motion as coming in different degrees amongst "subjects uniting more or less of the most sure and valuable investigations of science with the most imaginary and unprofitable speculation, that are continually passing through their various phases of intellectual, experimental, or commercial development, some to be established, some to disappear, and some to recur again and again, like ill weeds that cannot be extirpated, yet can be cultivated to no result as wholesome food for the mind."

Fifty Years Later.

Fifty years have fled, and Hunt, Grove, Smee, Tyndall, Cowper, Joule, Bidder, and Stephenson have long passed away. Lord Kelvin remains the sole and honoured survivor of that remarkable symposium. But the electric motor is a gigantic practical success, and the electric motor industry has become a very large one, employing thousands of hands. Hundreds of factories have discarded their steam-engines to adopt electric-motor driving. All travelling cranes, nearly all tramcars, are driven by electric motors. In the navy and in much of the merchant service the donkey-engines have been replaced by electric motors. Electric motors of all sizes and outputs, from one-twentieth of a horse-power to 8,000 horse power, are in commercial use. One may well ask: What has wrought this astonishing revolution in the face of the unanimous verdict of the engineers of 1857?

The answer may be given in terms of the action and reaction of pure and applied science. Pure science furnished a discovery; industrial applications forced its development; that development demanded further abstract investigation, which in turn brought about new applications. It was beyond all question the development of the dynamo for the purposes of electrotyping and electric light which brought about the commercial advent of the electric motor. For about that very time Holmes and Siemens and Wilde and Wheatstone were at work developing Faraday's magneto-electric apparatus into an apparatus of more practical shape; and the electric lighthouse lamp was becoming a reality, which Faraday lived to see before his death in 1867. That eventful year witnessed the introduction of the more powerful type of generator which excited its own magnets. And even before that date a young Italian had made a pronouncement which, though it was lost sight of for a time, was none the less of importance. Antonio Pacinotti in 1864 described a machine of his own devising, having a specially wound revolving ring-magnet placed between the poles of a stationary magnet, which, while it would serve as an admirable generator of electric currents if mechanically driven, would also serve as an excellent electric motor if supplied with electric currents from a battery. He thereupon laid down the principle of reversibility of action, a principle more or less dimly foreseen by others, but never before so clearly enunciated as by him. And so it turned out in the years from 1860 to 1880, when the commercial dynamo was being perfected by Gramme, Wilde, Siemens, Crompton, and others, that the machines designed specially to be good and economical generators of currents proved themselves to be far better and more efficient motors than any of the earlier machines which has been devised specially to work as electro-magnetic engines. Moreover, with the perfection of the dynamo came that cheap source of electric currents wnich was destined to supersede the battery. That a dynamo driven by a steam-engine furnishing currents on a large scale should be a more economical source of current than a battery in which zinc was consumed, does not appear to have ever occurred to the engineers who, in 1857, discussed the feasibility of electric motive power. Indeed, had any of them thought of it, they would have condemned the suggestion as chimerical. There was a notion abroad—and it persisted into the eighties—that no electric motor could possibly have an efficiency higher than 50 per cent. This notion, based on an erroneous understanding of the theoretical investigations of Jacobi, certainly delayed the progress of events. Yet the clearest heads

of the time understood the matter more truly. The true law of efficiency was succinctly stated by Lord Kelvin in 1851, and was recognised by Joule in a paper written about the same date. In 1877 Mascart pointed out how the efficiency of a given magneto-electric machine rises with its speed up to a limiting value. In 1879 Lord Kelvin and Sir William Siemens gave evidence before a Parliamentary Committee as to the possible high efficiency of an electric transmission of power; and in August of the same year, at the British Association meeting at Sheffield, the essential theory of the efficiency of electric motors was well and admirably put in a lecture by Professor Ayrton. In 1882 the present author designed, in illustration of the theory, a graphic construction, which has been ever since in general use to make the principle plain. The counter-electromotive force generated by the motor when running, which Hunt and Tyndall deplored as a defect, is the very thing which enables the motor to appropriate and convert the energy of the battery. Its amount relatively to the battery's own electromotive force is the measure of the degree to which the energy which would otherwise be wasted as heat is utilised as power. Pure science stepped in, then, to confirm the possibility of a high efficiency in the electric motor *per se*. But pure science was also brought into service in another way. An old and erroneous notion, which even now is not quite dead, was abroad to the effect that the best way of arranging a battery was so to group its component cells that its internal resistance should be equal to the resistance of the rest of the circuit. If this were true, then no battery could ever have an efficiency of more than 50 per cent. It was supposed in many quarters that this misleading rule was applicable also to the dynamo. The dynamo makers discovered for themselves the fallacy of this idea, and strove to reduce the internal resistance of the armatures of their machines to a minimum. Then the genius of the lamented John Hopkinson led him to apply to the design of the magnetic structure of the dynamo abstract principles upon which a rational proportioning of the iron and copper could result. A similar investigation was independently made by Gisbert Kapp, and between these accomplished engineers the foundations of dynamo design was set upon a scientific basis. To the perfection of the design the magnetic studies of our ex-President, Professor Ewing, contributed a notable part, since they furnished a basis for calculating out the inevitable losses of energy in armature cores by hysteresis and parasitic currents in the iron when subjected to recurring cycles of magnetisation. Able constructive engineers, Brown, Mordey, Crompton, and Kapp, perfected the structural development, and the dynamo within four or five years became, within its class, a far more highly efficient machine than any steam-engine. And as by the principle of reversibility every dynamo is also capable of acting as a motor, the perfection of the dynamo implied the perfection, both scientific and commercial, of the motor also. The solution in the eighties of the problem how to make a dynamo to deliver current at a constant voltage when driven at a constant speed, found its counterpart in the solution by Ayrton and Perry of the corresponding problem how to make a motor which would run at constant speed when supplied with current at a constant voltage. Both solutions depend upon the adoption of a suitable compound winding of the field magnets.

A little later alternating currents claimed the attention of engineers; and the alternating current generator, or "alternator," was developed to a high degree of perfection. To perfect a motor for alternating currents was not so simple a matter. But again pure science stepped in, in the suggestion by Galileo Ferraris of the extremely beautiful theorem of the rotatory magnetic field, due to the combination of two alternating magnetic fields equal in amplitude, identical in frequency and in quadrature in space, but differing from each other by a quarter-period in phase. To develop on this principle a commercial motor required the ingenuity of Tesla and the engineering skill of Dobrowolsky and of Brown; and so the three-phase induction motor, that triumph of applied science, came to perfection. Ever since 1891, when at the Frankfort Exhibition there was shown the *tour de force* of transmitting 100 horse-power to a distance of 100 miles with an inclusive efficiency of 73 per cent., the commercial possibility of the electric transmission of power on a large scale was assured. The modern developments of this branch of engineering and the erection of great power-Stations for the economic distribution of electric power generated by large steam plant or by water-turbines are known to all engineers. The history of the electric motor is probably without parallel in the lessons it affords of the commercial and industrial importance of science.

But the query naturally rises: If a steam-engine is still needed to drive the generator that furnishes the electric current to drive the motors, where does the economy come in? Why not use small steam-engines, and get rid of all intervening electric appliances? The answer, as every engineer knows, lies in the much higher efficiency of large steam-engines than of small ones. A single steam-engine of 1,000 horse-power will use many times less steam and coal than a thousand little steam-engines of 1 horse-power each, particularly if each little steam-engine requires its own little boiler. The little electric motor may be designed, on the other hand, to have almost as high an efficiency as the large motor. And while the loss of energy due to condensation in long steam-pipes is most serious, the loss of energy due to transmission of electric current in mains of equal length is practically negligible. This is the abundant justification of the electric distribution of power from single generating centres to numerous electric motors placed in the positions where they are wanted to work.

BRITISH TRADE UNION STATISTICS.

The fifteenth Report by the Chief Labour Correspondent of the Board of Trade on Trade Unions in 1902-04* gives, in addition to the detailed figures as to membership during 1904, comparative statistics between 1895-94. The report sets out a number of interesting facts and figures.

The number of separate workman's Trade Unions known to the Department as being in existence at the end of 1904 was 1,148, with a total membership of 1,866,755. In the three years of declining employment, 1902-04, there has been, as in previous periods of depression, a falling off in the membership of many Trade Unions. The total decline is from 1,940,874 at the end of 1901 (when the numbers were the highest recorded) to 1,866,755 at the end of 1904, a fall of 74,119 or 3·8 per cent. The total number of trade unionists remained, however, higher than at the end of 1899, and much higher than during the period 1892-98, the earliest years for which comparative figures are available. The decline was not so marked in the larger as in the smaller unions. The labourers' unions suffered most, trade unions of builders' and general labourers losing in the three years 30,000 members, or no less than 19·4 per cent. of their membership in 1901. The mining and quarrying group also lost nearly 30,000, but this represents a fall of only 5·5 per cent. of the membership of the group. These two groups account for more than three-fourths of the total. Considerable losses were also sustained by the tailoring group (18 per cent.) and the transport group (7 per cent.). On the other hand a comparatively large increase in trade union membership took place during 1902-04 in the small groups of employees of Public Authorities, which gained 12,000 (or 23·6 per cent.), and of shop assistants, which increased from 19,000 to 30,000, a gain of 60·0 per cent. A gain of 7·1 per cent. by the printing and kindred trades group has also to be recorded.

Taking the hundred principal unions only it is interesting to note an increase in membership during the ten years under review from 907,496 to 1,127,529. The income per member has been a varying quantity, ranging from 33s. 11¾d. in 1895 to 37s. 4¼d. in 1897, falling to 33s. in 1899, and since rising to 37s. 2½d. The expenditure per member has been a varying quantity, notable years being in 1897, 36s. 0¼d.; in 1899, 22s. 8d.; and in 1904, 36s. 2¾d. The value of the accumulated funds per member were 37s. 8¾d. in 1895, 44s. 11d. in 1896, fell to 42s. 0¼d. in 1897 (being depleted by disputes), and have since risen to 81s. 10½d. The rate of increase in funds is slackening appreciably.

During the ten years under review £16,060,000 has been spent by the 100 principal unions. Of this amount about £2,343,000, or 14·6 per cent. of the total, has been spent on dispute pay, £3,608,000, or 22·5 per cent., on unemployed benefits, and £6,658,000, or 41·4 per cent., on other benefits (principally sick and accident, superannuation, and funeral benefits), the remaining £3,451,000, or 21·5 per cent., having been used in the payment of working and miscellaneous expenses.

The proportion of the total expenditure accounted for by disputes in the last four years has fallen considerably. In 1904 a smaller proportion was spent on dispute pay, and a larger proportion on unemployed benefit than in any other year. In the first five years the proportion spent on unemployed benefit steadily fell with the improvement in employment. In the remaining five years, 1900-04, owing to the decline in employment, the proportion gradually increased until in 1904 it was higher than in 1895, and more than twice as great as in 1899 (a year of exceptionally good employment) amounting to 31·7 per cent. of the total expenditure, whereas 6·2 per cent. was expended on dispute benefit. The proportionate extent of working and miscellaneous expenditure has fallen from 25·8 per cent. in 1899 to 22·4 per cent. in 1894.

Passing next to the items comprising the detailed report, it is stated that "Concurrently with the general increase in unemployment during the period 1902-4, and in agreement with the experience of previous similar periods, there has been a decline in the number of members of trade unions. The total membership, which had reached 1,940,874 in 1901, fell in each of the years 1902-4, and at the end of the period was 1,866,755. It still remained, however, higher than at the end of 1899, and was much higher than at the end of any year during the period 1892-98, the earliest years for which comparative figures are available."

As compared with 1901, except in the textile trades, which on the whole show little change, all the main groups of trades have sustained a decline in membership. In the metal, engineering, and ship building trades the loss amounts to only 0·8 per cent., but in the mining and quarrying group it is 5·5, in the transport group 7·0, in the building group 9·6, and in the clothing group 11·0 per cent. In the building trades the loss was felt chiefly by the labourers' unions, their membership declining by one-third. The other building trade unions lost 5 per cent., notwithstanding a notable increase of 3,745 in the membership of the Amalgamated Society of Carpenters and Joiners. In the clothing trades the tailors' unions were the heaviest losers, their membership falling 18 per cent. The other unions in the clothing trades lost 7 per cent.

Generally speaking, the unions which have suffered least in loss of members are those paying the most varied and liberal scales of benefits.

Some interesting figures relating to the manner in which female workers support the trade union movement are given. While, during the years 1896-1904, the male membership of all trade unions has risen from 1,386,709 to

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* No. Cd. 2838. Price 1s. 2d., published by Wyman and Sons, Ltd., Fetter-lane, E.C.

1,741,661, the female membership has remained almost stationary at about 120,000.

As regards individual trades, the only group worthy of note as having shown a substantial rise in membership is that of the shop assistants' unions, whose female membership rose, without a break, from 327 in 1896, to 1,609 in 1901, and 3,739 in 1904.

Nearly 90 per cent. of female members of trade unions are found in the textile trades, cotton weaving accounting for 60 per cent., cotton preparing for 18 per cent., and linen and jute manufacture for 8 per cent.

Another section deals with the income of the principal unions, in which it is shown that the average receipts per head of the principal unions during the ten years ending 1904, were as follows:—

	£	s.	d.
Building	1	16	7¼
Mining and Quarrying	1	2	6¼
Metal, Engineering, and Shipbuilding	3	5	11½
Textile	1	12	1
Clothing	1	4	11¼
Transport	1	0	8
Other unions	1	5	2¼

The figures relating to the metal, engineering, and shipbuilding trades are inflated by the dispute of 1897-98. Excluding these years, the income for the remaining eight was £3 2s. 8¾d.

Percentage expenditure for all the unions has already been referred to. Specific figures are given of groups of trades. As has been said, dispute benefits have been greatly reduced, but unemployed benefits have risen considerably. Sick and accident payments have also risen, the cost under the latter head having risen from 5s. 2½d. per member of the 100 principal unions in 1898 to 6s. 9¾d. per member in 1904.

Another valuable piece of work, namely, that of superannuation benefit, is unfortunately paid by a comparatively small number of the 100 unions, principally in the engineering, shipbuilding, building, and printing trades. None of the miners', weavers' and labourers' unions pay this benefit; but in the case of the miners it is provided by Miners' Permanent Relief Societies. The form taken by superannuation benefit is in nearly all cases that of a weekly payment, such payments varying greatly in amount. In some cases no more than 2s. a week is paid; in a few instances the amount reaches 12s. per week. More commonly, however, it lies between 5s. and 10s. A point of interest is that the fact that a member of a union paying superannuation benefit has arrived at a certain age, and has completed the prescribed period of membership does not necessarily entitle him to the benefit. The rules of some of the unions state that, in order to be eligible for the benefit, a member must be unable to work at his trade, or at any rate be unable to earn full wages. Expenditure upon this heading is becoming annually a more important matter. Costing 6s. 2¾d. per member of these unions in 1898, by 1904 this sum had risen to 9s. 7¼d., or over 50 per cent.

Another section of the detailed report deals with the accumulated reserve funds of the 20 chief unions which in 1894 possessed funds amounting to £50,000 and upwards. The funds of these twenty unions amounted at the end of 1904 to £3,628,243, or 79 per cent. of the funds of the 100 principal unions. Only two of the twenty show a decrease in funds per member as compared with 1895, and most of them show a large increase, the Derbyshire and Nottinghamshire miners having gained over £5 per member, the Ironmoulders of Scotland and the Patternmakers over £6, and the Cotton Spinners over £13.

The disposition of the funds of the 100 principal unions, which amount to £4,616,230, consists of £1,943,786 deposited in banks, cash in hand and office furniture (this item being "a very small proportion of the total amount"), and the following chief investment. —Corporations and public trusts £1,361,167, railways £198,655, freehold and leasehold property £238,933, and mortgages £442,880.

Federations of Trade Unions and Trades Councils are described together with the scope of their activities. The remainder of the book is given to diagrams illustrative of membership, expenses, income, funds, &c., and to a most exhaustive series of tables relating to the number and membership of all trade unions, to the accounts of the 100 principal trade unions, and to statistics respecting federations and trades councils. The interest of these is general rather than precise. Reference to them is, therefore, unnecessary in this abstract.

IRON ORE SUPPLIES.*

Of all the problems with which the practical geologist has to deal, none is of greater importance at the present time than the discovery of fresh sources of iron ore supply. Every inhabitant of the United Kingdom, of the United States, and of Germany requires annually about a quarter of a ton of the iron of which the world last year produced 60,000,000 tons, the result of the smelting of over 120,000,000 tons of ore. Year by year the production and consumption are increasing, and many of the deposits of the richer ores are showing signs of depletion. The question of ascertaining how the demand for the vast supplies of iron ore that will in the future be needed will be met, calls therefore, for very serious consideration; and a few statistical notes may be useful as a contribution to a discussion of the subject.

During the past half century the development of the iron industry has been remarkable. In 1864, Mr. J. K. Blackwell showed that the world's production of pig-iron did not exceed 6,000,000 tons, of which the United Kingdom produced 50 per cent., France and the United States each 12½ per cent., and Germany 6 per cent. In 1905 the world's production

* Paper read by Bennett H. Brough, Assoc.R.S.M., F.G.S., F.I.C., before Section C of the British Association, at Leicester.

had attained the enormous total of 56,000,000 tons, of which the United States produced 42·7 per cent., Germany and Luxemburg 20 per cent., the United Kingdom, 17·6 per cent., and France 5·5 per cent.

In Great Britain the principal iron-ore producing districts are Cleveland, in North Yorkshire, which in 1905 yielded 41·0 per cent. of the total output of the kingdom; Lincolnshire (14·8 per cent.), Northamptonshire (13·9 per cent.), and Leicestershire (4·7 per cent.), together yielding 33·4 per cent. of the total output; Cumberland (8·6 per cent.), and North Lancashire (2·7 per cent.), Staffordshire (6·1 per cent.), and Scotland (5·7 per cent.). The Cleveland iron ore occurs in a 10-foot bed in the middle lias, and contains about 30 per cent of iron. It is worked by underground mining. In Lincolnshire, Northamptonshire, and Leicestershire the brown iron-ore beds form part of the Inferior Oolite, and contain about 33 per cent. of iron, the workings being mostly opencast. In Cumberland and North Lancashire the red hæmatite occurs in irregular masses in carboniferous limestone. It contains more than 50 per cent. of iron, and is worked by underground mining. The ironstone in Staffordshire and in Scotland is mostly obtained from mines that also produce coal.

Such, in brief, are the home deposits from which the British supply of 14,590,703 tons of iron ore, valued at £3,482,184 was obtained in 1905. Even that enormous output did not meet the consumption, and 7,344,786 tons were imported. Of that amount, 78·5 per cent. was brought from Spain, 5·4 per cent. from Norway, 4·2 per cent. from Greece, 4·0 per cent. from Algeria, 2·6 per cent. from France, 2·6 per cent. from Sweden, 1·5 per cent. from Russia, and smaller quantities from Turkey, Germany, islands in the Pacific, Belgium, Newfoundland, India, Australia, Italy (Elba), Persia, Portugal, and other countries. In fact, the world is being ransacked for fresh iron-ore fields to supply ores for the British blast-furnaces. The port at which most of the ore was delivered was Middlesbrough (1,789,639 tons), then followed Glasgow with 1,042,179 tons, and then Cardiff with 865,462 tons.

While it is probable that the British ore fields will be exhausted in a century or two, the outlook in other countries is similar. This is borne out by data relative to the available iron ore supplies of the world which have been collected by Törnebohm for the Swedish Parliament, and, although largely conjectural, these figures are of great interest.

In the United States the iron-ore production in 1905 exceeded 42½ million tons, the highest output ever recorded, the ore containing more iron than the ores raised in Germany, in the United Kingdom, and in Spain combined. The bulk of the production was obtained in the Lake Superior region, where the five iron-ore belts, or ranges (Marquette, Menominee, Gogebic, Vermilion, and Mesaba), beds of pre-Silurian Age, have furnished since the beginning of regular mining over 300,000,000 tons of iron ore. The average percentage of iron in the ore is 55, the 60 per cent. ores produced ten years ago having been exhausted by wasteful mining methods. The amount of ore still available in the United States is estimated by Törnebohm at 1,100,000,000 tons.

In Germany and Luxemburg two-thirds of the iron ore raised (23½ million tons in 1905) is derived from the so-called minetic beds of Jurassic brown iron ore. The seams yield, on an average, 36 per cent. of iron, and 1·7 per cent. of phosphoric acid. Owing to the high percentage of phosphorus the ore was of little value until 1879, when the basic method of making steel was brought into practical use by Thomas and Gilchrist. The amount of ore still available in Germany is estimated at 2,200,000,000 tons.

In Spain the chief deposits are near Bilbao; the ores, which are of great purity, occurring in beds of Cretaceous age. Up to the present time the Bilbao district has yielded about 115,000,000 tons of ore, and for many years pessimistic estimates have been made of the quantity of ore remaining. Twenty years ago it was thought that by the year 1900 there would be no ore left. Nevertheless, in that year Bilbao exported 5,000,000 tons of ore, and Don Julio de Lazurtegui, the most competent authority, estimated that there were still over 57,000,000 tons left. The richest red hæmatite ores are, it is true, now exhausted, and brown hæmatites and spathic ores have taken their place, with the result that more attention has to be paid to calcination and to the washing of ores to enable them to satisfy market requirements. Törnebohm's estimate of the quantity of ore still available in Spain is 500,000 tons.

In Sweden, deposits of magnetite of great purity occurring in gneiss supply material for the charcoal blast furnaces, and ores rich in phosphorus are mined for export at Grängesburg, in central Sweden, and within the Arctic Circle at Gellivare, Kirunavaara, and Luossavara, where there are ample supplies to meet the increased demand that is likely to arise. These deposits have been described in great detail by Dr. Stutzer in a paper submitted at the last meeting of the Iron and Steel Institute. The export of iron ore from Sweden in 1905 amounted to 3½ million tons. In Northern Norway important discoveries of similar iron ore deposits have of late been made. The amount of ore still available in Sweden is estimated at 1,200,000,000 tons.

In France the most important deposits are the beds of oolitic iron ore in the department of the Meurthe-et-Moselle; and in Russia the greater portion of the iron ore produced is obtained from the Ural region, where, on the western side, the ores are chiefly limonite and spathic ores of a stratified character, and, on the east, masses of magnetite associated with igneous rocks. The amount of ore available in France is estimated at £1,500,000,000 tons, and in Russia at the same amount. The available resources of other countries are estimated by Törnebohm at 1,200,000,000 tons. Including 1,000,0 0,000 tons for Great Britain, he estimates

the known available resources of the world at 10,000,000,000 tons.

The outlook for the British industry is not altogether a depressing one, for, whilst the rich ores of Bilbao and Elba are becoming scarce, there are still vast quantities of ore available in the north of Scandinavia, in the south of Spain, in Algeria, Canada, Cuba, Brazil, Venezuela, Chili, India, China (notably in the Shansi district), Australia, and South Africa. The high cost of carriage is, of course, an important factor; but the great economies which have, and will be, effected in transport will reduce this item. The future of the home demand is likely to be affected by the development of the basic open-hearth process of steel-making which enables phosphoric ores to be utilised. In the course of time such phosphoric ores will doubtless occupy a very prominent place in the manufacture of high-class steel. The development of magnetic concentration and of the briquetting of pulverulent ores for furnace use will render possible greater utilisation of poorer ores, while the development of the electric furnace will doubtless render it possible to utilise black sands and other titaniferous iron ores which, although met with in abundance, cannot at present be treated profitably in the blast-furnace. There need therefore be no immediate anxiety regarding the supply of the more impure ores, the application of which cannot fail rapidly to increase.

THE AGRICULTURAL INDUSTRIES OF THE PHILIPPINES.

The most important product of the Philippine Islands at present is the fibre known throughout the civilised world as Manila hemp. It is not a hemp in the ordinary acceptation of the term, as the fibre is produced from the leaf of a large plant similar in appearance to the banana plant or tree, while in most cases hemp is the fibre extracted from the inner bark of the stem of a plant. Manila hemp, or "abaca" as it is termed, is apparently a strictly Philippine product, and holds a high rank among the fibres of the world for manufacturing purposes. Abaca has been introduced from the Philippines into India, Borneo, the West Indies, and elsewhere, but apparently without success, and this failure to produce it elsewhere adds to the importance of the industry in the Philippines and to its probable development. According to the Fibre Expert of the Philippine Bureau of Agriculture, the opportunities for increasing its production are almost unlimited. The production of hemp has grown rapidly in recent years, the exportation having been, in 1880, but 51,000 tons; in 1890, 50,000 tons; in 1900, 89,000 tons; and in 1905, 128,000 tons, while the value has increased from £1,000,000, in 1880, to £4,400,000, in 1905. With the adaptation of machinery to the preparation of hemp for marketing, the area cultivated will doubtless greatly increase, and as the world is constantly demanding all the hemp which the Philippines can at present offer, there is reason to believe that this industry may be greatly developed, and the exports of this article may, it is said, alone amount to £20,000,000 in value.

Another plant of the hemp family which is likely to become an important factor in the wealth production of the Philippines is maguey or sisal. Sisal ranks next to Manila hemp among the coarse and strong fibres needed for the manufacture of ropes, binding twine, &c. So important has it become in the manufacturing industries of the world that its importation into the United States alone has grown from £700,000 in 1896 to £3,050,000 in 1906. At present nearly all the sisal imported into the United States is brought from Mexico, where the production has, within a comparatively recent period, made Yucatan one of the richest States in the Republic. While the plant was introduced many years ago, probably from Mexico, it is only during the last few years that planters in the Philippine Islands have devoted attention to its production and development, and therefore only recently that its value as a fibre plant, and prospective value to the commerce of the Philippines, have been realised. The machinery used for fibre extraction in the sisal regions of Mexico applies, it is said, with equal satisfaction to the maguey plant in the Philippines. The growth of the maguey industry in the Philippine Islands during the past four years indicates that it will, at no distant date, become one of the important agricultural products. Maguey has one advantage over abaca in that, in its cultivation, it cannot be blown down or uprooted by violent winds. Another fibre in the cultivation of which experiments have been made is jute, but so far the experiments have not proved very satisfactory, and the world is at present chiefly dependent upon India for jute.

Sugar is perhaps the next important article after hemp in the production of the islands. The production of sugar in the Philippines has never at its very highest figure exceeded 350,000 tons, nor is the present production for export more than 100,000 tons annually. The United States demands annually 2,000,000 tons, and the whole world demands over 12,000,000, and there is good reason to believe that the sugar exports of the Philippines, which in 1905 were but one million sterling in value, may far exceed that figure with the introduction of modern machinery, the enlargement of the area which sugar-producing estates may control, and the bringing into cultivation of large sugar areas not now utilised. In the period from 1860 to 1890, the share which sugar formed of the total exportation ranged from 25 to 50 per cent., and in two or three years exceeded 50 per cent. of the total exports, while in the period since 1900 it has formed only from 10 to 15 per cent. of the total exports, and the quantity exported has fallen from about 700,000,000 lbs. in 1895, to 239,000,000 lbs. in 1905. Tobacco is classed as the third agricultural product of the islands in point of commercial importance. Originally introduced from America into the

Philippines by Spanish missionaries in the latter part of the sixteenth century, its cultivation has extended throughout the group of islands, but it is especially grown in the northern part of the most northerly island, Luzon. The home consumption is large, and in consequence the quantity available for exportation is comparatively small, having at no time in the last thirty years reached as much as £600,000 in value. Most of the tobacco exported goes in the natural form. The cocoanut and its products now form a considerable and rapidly-increasing percentage of the exports from the Philippine Islands. Copra, or the dried meal of the cocoanut, now ranks third in the total exports of the islands. In 1905 it amounted in value to £650,000, and in the fiscal year 1906 to £809,000. This large growth in the exportation of copra is due to the developments of recent years by which the nuts may be readily transported in a dried or desiccated state to those countries which have facilities for utilising the oil for manufacturing purposes. From it cocoanut oil and cocoa butter are manufactured, and the residuum, after expression of the oil, is an excellent food for stock, with many of the nutritive properties of cotton seed cake. The *Phillipine Census*, discussing this industry, says that copra is a comparatively new product and bids fair to become of much greater relative importance in the commerce of the Philippines than at present. In view of the increasing demand for cocoanut products this industry, when prosecuted upon a large scale, promises to be for many years one of the most profitable enterprises which command the attention of the Philippine planter, while the area available for production of cocoanuts is very large.

Coffee is not at present a very large item in the export trade of the Philippine Islands, or indeed of great importance from the point of view of production. Prior to 1890 it was a remunerative product of certain provinces, and constituted a source of considerable wealth in the districts in which it was cultivated. In 1890 coffee ranked fourth in order of magnitude in the export trade of the islands, and did not fall below tobacco in the value of its exports, having been in 1890 7·4 per cent., and in 1889 7·1 per cent. of the total exports of the islands. Subsequent to 1890, however, the devastation of the coffee plantations by insects and disease caused a rapid diminution in the quantity produced and exported, but there is reason to believe that the same energy and scientific methods applied by the Dutch in Java to the protection of their coffee from insects and disease, and a re-establishment of their coffee area might bring about a large coffee production in the Philippine Islands. The quality of the Philippine coffee is said to be especially fine, comparing favourably with that of the comparatively near-by island of Java. Coffee was brought to the islands by Spanish missionaries during the latter part of the eighteenth century, and its systematic cultivation commenced early in the nineteenth century. Cacao is another article in which the production and commerce of the Philippine Islands may be largely developed. Cacao cultivation exists in nearly all parts of the archipelago, and with the growing demand in all parts of the world for this product, it seems probable that it may become an important wealth producer in the islands, and add materially to their commerce. The cultivation of the cacao plant, from the seed of which chocolate is obtained, is carried on in various parts of the slands, and in spite of crude and wasteful methods has proved a highly profitable and promising branch of agriculture. No appreciable commercial surplus of the product has yet been grown, practically the entire output being consumed in the islands, but the perfect adaptability of many districts to its successful cultivation, the superior quality of the chocolate produced from it, and the certainty of remunerative returns from the industry, lead to the belief that this may become a profitable branch of agriculture, and will hereafter be carried on more extensively, and add materially to the value of Philippine exports.

CAUSES OF STRENGTH IN WHEATEN FLOUR.*

The Home-grown Wheat Committee of the National Association of British and Irish Millers has for several years been engaged in producing wheats in England which shall yield maximum crops of grain and straw, the wheat to be equal in strength, and therefore in commercial value, to the best imported varieties.

The field of inquiry has been a wide one, and among other things the Committee has sought to ascertain "the ultimate cause of strength in wheat, the nature and source of those constituents which confer on some varieties of wheat the inherent quality of strength, and the power of transmitting it to succeeding generations." It has been proved that though climate and soil influence quality they are not the determining factors in the production of strength, for though the strongest wheats are ordinarily produced in districts where the winters are cold, the summers hot, and the summer rainfall high, certain varieties possess and retain the inherent quality of strength when grown in England. Manuring or early cutting at harvest time has no beneficial effect on quality. Quick growth or rapid maturation is not correlated with strength, nor does the percentage of natural moisture in well-harvested wheat indicate it; indeed in certain cases the addition of water to wheat materially increases its effective baking strength.

The term "strength" has been loosely applied to cover several characteristics. In the view of the Committee it should not be measured by the quantity of water required to make doughs of a standard consistency, nor by the quantity of bread produced per sack of flour used, nor by the way a flour behaves in the

* Abstract of paper read by Mr. A. E. Humphries before Section B of the British Association, at Leicester.

dough, but by its capacity for making big, shapely, and therefore well aerated loaves. This definition covers two characteristics: one, a flour's capacity for making gas in yeast fermentation; the other, its capacity when made into dough for retaining the gas so generated.

The gas-making power will depend largely on the percentage of natural sugar any given wheat contains and its diastatic capacity. These characteristics vary substantially in different wheats. The baker can, and does, influence the quantity of gas generated in baking. The retention of gas when made involves complex problems.

The percentage of total nitrogen, gluten, gliadin, and amyloids do not correctly indicate the relative strengths of various flours. The theory of strength depends on a correct ratio between gliadin and glutenin is untenable. Professor Wood's suggestion that the gas-retaining power of a dough depends on its ratio of protein to salts is worthy of the closest attention in view of the fact that the physical, as distinct from the chemical, properties of proteins are profoundly affected by small quantities of acids, alkalis, and salts.

FRENCH SILK SCHOOLS.

The Ecole Supérieur de Commerce in Lyons, the centre of the French silk industry, receives pupils from foreign countries, and teaches them the entire silk business, from the raising of the worm, to making the designs, weaving the silk and putting it upon the market. While a pupil is at this school learning to make silk, he can also acquire a thorough knowledge of the French language. A two years' course of study includes loom and weaving instruction, commercial law, political economy, book-keeping, and modern languages, the charge for foreigners being £40 per annum. At the end of the two years' course, the pupil never has any difficulty in obtaining a situation in one of the silk houses of Lyons. The two silk schools in Lyons are expected to supply young men for the silk houses in that city and in others also. The second school in Lyons, teaching the silk business, is the Ecole Municipal de Tissage et de Broderie, which is owned by the city and is intended only for the children of the inhabitants. It is free, with the exception of a registration fee of two shillings and sixpence. The American Consul at Lyons says that foreigners, however, are admitted on equal terms with the natives. It is not known how long this will be continued. It has been proposed to suspend their admission, but they continue to attend and enjoy all the advantages of the school for the sum of two shillings and sixpence for the two years. In each of these schools a young man has all the advantages of learning a good business, and at the same time the language and social habits and customs of the country.

HOME INDUSTRIES.

The Agricultural Returns. — The Preliminary Statement for 1907 has just been issued by the Board of Agriculture and Fisheries, and shows that the total acreage under wheat has again receded. For many years there was constant decline, but in 1905 there was marked expansion in the area under wheat cultivation. In 1904 it had fallen to 1,407,618, a much lower acreage than any since these statistics were first kept. Under the influence of better prices, 1905 saw a substantial increase to 1,836,598 acres, but last year the area under wheat fell away to 1,755,696, and this year it is only 1,625,488 acres, or, excepting the years 1903 and 1904, the lowest on record. Barley also shows a decrease, comparatively small, from 1,751,238 acres to 1,712,166 acres. Oats, beans, peas are all larger, and the total acreage under clover and rotation grasses has increased from 4,440,746 to 4,491,028 acres, whilst permanent grass has increased again from 17,244,734 acres to 17,278,243. It is satisfactory to find that the area under fruit continues to increase steadily if slowly. The improvement as between last year and this is as from 80,226 acres to 82,167 acres. Ten years ago the acreage under small fruit was only 70,245. As was anticipated, the disastrous results of last year have led to a further contraction of hop cultivation. In 1906, the area under this cultivation was only 46,722 acres, this year it has fallen to 44,938 acres. The probabilities point to further contraction in this cultivation, agriculturists being more and more disinclined to handle a crop where the risks are always very great and the lean years more frequent than the fat ones. On broad grounds this contraction is much to be regretted, for there is no crop grown that employs anything like as many hands. Turning to live stock, the preliminary statement shows that the number of horses used for agricultural purposes, and of unbroken horses, continues to decrease. In 1906 the number was 1,568,681, this year only 1,556,407. Ten years ago the figures were 2,069,880. Cattle too have fallen from 7,010,856 to 6,912,519. Ten years ago the figures were 11,004,973. Sheep, on the other hand, have recovered somewhat from 25,420,360 to 26,116,503, but here, again, as compared with earlier years, the figures show large decreases. It is the same with pigs. They have increased, as compared with 1906, from 2,323,461 to 2,636,808, but in 1897 they numbered 3,683,043, and in 1891, 4,272,700. If the total acreage under all crops and grass is taken, it amounted in 1906 to 32,266,755, and this year it is somewhat less, 32,244,110 acres.

The Wealth of the Kingdom.—The great and growing wealth of the United Kingdom is shown by the Income-tax records to be found in the Annual Report of the Commissioners of Inland Revenue issued a few days ago. The gross income from all classes of profits brought under the review of the department amounted in 1905-6 to £925,184,556.

These figures apply to not much more than one-ninth of the population. Year by year the aggregate increases by several millions. The income on which income-tax was received in 1905-6 amounted roughly to £636,000,000, and the actual sum received was £31,891,949, or a trifle over 5 per cent. In the eleven years 1896-97—1906-07 the net receipt of income-tax has almost doubled, increasing from £16,901,341 to £31,891,949, but, of course, the increased rate has a good deal to do with this growth, the income on which the tax was received having grown only from £503,664,630 to £636,000,000. It may be noticed that whilst the net receipt of the tax has in England increased from £14,715,755 to £28,024,957, and in Scotland from £1,519,336 to £2,687,957, in Ireland the increase is only from £665,950 to £999,246.

The Cotton Industry.—Notwithstanding a considerable number of new mills which have not yet got into working order, and which follow the great increase of mills during the last two or three years, other new mills are being put up and projected. As explained in a recent Note, the new mills at present being erected have been delayed owing to the inability of the machinists to deliver within contract time, or anywhere near it. The prospects of the American cotton crop remain uncertain, but good reports come from the Atlantic States and the Eastern Gulf region, and if the reports are less favourable from Tennessee, Mississippi, Louisiana, Texas, and the south-west generally, Manchester seems to be pretty well satisfied that the crop will be an average one, and the surplus carried on at the end of this season will be larger than last. Taking July the exports of cotton piece goods show about the same increase over those of 1906, as the exports of that year showed expansion over the same month of 1905, the figures being for 1905 510,440,000 yards, for 1906 573,527,800 yards, and for 1907 634,158,000 yards, but although the aggregate of the first seven months of the present year (3,769,999,000 yards) shows a considerable increase over the exports for the corresponding seven months of 1906 (3,690,231,400 yards), it is a good deal less than the increase in the same months of 1906 over those of 1905 (3,515,911,300 yards). The exports of bleached, printed, and coloured goods have been larger this year, but there has been a falling off in the exports of grey and unbleached calico. Exports of yarn also show a large increase. Taking the seven months, the exports of 1905 were 114,158,000 lbs.; of 1906, 122,452,200 lbs.; and of 1907, 135,874,100 lbs., the increase in 1907 over 1906 being considerably larger than those of 1906 over 1905. The exports to Germany account for much, indeed, almost all this year's increase, it being 12,000,000 lbs. more than in the same period of 1906. There are some grounds for fear that the relations of cotton masters and men may take an unfavourable turn after the holidays, but if this danger is averted, and the supplies of raw material come up to expectation, the Lancashire cotton industry is likely to enjoy a further period of prosperity. The past week was noticeable for the arrival at Liverpool of a consignment of over 1,050 bales of cotton from Nigeria. The cotton is said to be of useful quality, and to be excellently baled. The West Indies too are making some headway in the growth of cotton, and it is estimated the next year, 1907-8, will see shipments of cotton lint and seed from the islands of a value of a quarter of a million sterling.

The Shoe Industry.—For some time past the Leicester shoe industry has not been in a flourishing condition. More and more the large industrial villages of Leicestershire and Northampton have been making headway at the expense of the town. The invention of oil engines, and the adoption of up-to-date shoe machinery, have made this competition possible. The country factory has become almost as efficient as that of the town, and the town has to reckon with higher rents, heavier rates, higher wage bills. The result is that the town manufacturer is finding it increasingly difficult to quote successfully against his country rival. Within the past year many old-established Leicester firms have either retired from the business, or gone into the country, while firms owning both town and country factories are extending the latter rather than the former. The effect upon Leicester has been disastrous. There are many hundreds of empty houses in the town, and although there has been some improvement in the shoe trade, Leicester's rate of pauperism last month was exceeded (outside, however) only by Cardiff and the Potteries. Now war is threatened between masters and men. The two Leicester branches of the National Union of Shoe Operatives have given three months' notice to the Local Conciliation Board that they desire minimum wages of 32s. for men, and 21s. for women over 18, and that in view of the large number of men out of employment, they require the Board to discuss the question of abolishing overtime. At present pressmen and rough stuff cutters have a minimum of 26s., and other men 29s. per week. There is no minimum for women, but those who are 18 years of age or more earn from 12s. to 24s., according to the skill and the class of work on which they are engaged, the average being 14s. or 15s. It will be seen from these figures that the operatives demand a good deal, probably much more than they expect to get. The masters do not deny that it is a reasonable demand on the part of the men to require higher wages having regard to the rise in town rents, and the weeks in which there is no work to be had in the present state of things. Unfortunately, the profit of the Leicester manufacturer is now so narrow that he does not see his way to raise his wages bill. He would do it quickly enough if there was the prospect of corresponding advances being made throughout the trade, but there is not. There are said to be 400 non-federated firms through-

out the country who would not be bound by any agreement that might be made between the Leicester masters and men, and they employ over 50,000 people most of whom are unionists. This statement was made at the last annnal meeting of the Federation of Boot Manufacturers' Association in reporting on the union's proposal for a conference as to reducing the hours of work to forty-eight per week.

The State and Trade.—At the meeting of the Association of Chambers of Commerce which meets at Liverpool this month, the following resolution advocating the strengthening and consolidation of commercial organisation will be moved by the Birmingham delegates:—(1) The appointment of a Minister of Commerce of Cabinet rank; (2) the creation of an influential and thoroughly representative Advisory Board of Commerce; (3) the conferring of an official status upon the Chambers of Commerce; and (4) the provision of a complete system of intercommunication between the Chambers of Commerce and the Minister and his Advisory Board. The Prime Minister and the President of the Board of Trade will be asked to receive a deputation on the subject. Meantime, the Report of Sir Eldon Gorst and Mr. Llewellyn Smith on the System of British Commercial *Attachés* and Commercial Agents has been issued. It finds many defects in the present system. The expectation that British firms would utilise the services of the *attachés* for the purpose of conducting special inquiries at a distance has not been realised. The present arrangements for commercial agents are entirely provisional, and the framers of the Report can see no reason why their functions should not be equally well discharged by the Consular staff, strengthened where necessary for the purpose. The Report recommends that the existing commercial *attachés* residing in European capitals should have their head-quarters in London, and divide their time between special investigations abroad, particularly in districts of interest to British manufacturers, work in the Board of Trade, or the Commercial Department of the Foreign Office, and visits to the manufacturing districts in the United Kingdom.

CORRESPONDENCE.

IMPROVED METHODS OF DUST PREVENTION IN THE GRINDING TRADES.

The principle mentioned by Mr. Bennett in his communication upon grindstones, which appeared in your issue of August 30th, that the steel and stone dust fly from the wheels with considerable velocity, and that if they are to be arrested it must be by some obstacle placed in their path, and not by currents of air, was due to observations made by Dr. Whitelegge, the principal Inspector of Factories, and myself on a visit to Sheffield this spring. I cannot say how far this principle is a new one, but it is a valuable one as a starting point for the construction of hoods to grindstones. It should, however, not be pushed too far, for finer and lighter sorts of dust are impeded by the air in a ratio dependent on their degree of fineness, as has been demonstrated mathematically by the late Sir George Stokes (see p. 10, vol. ii. of his works). But with regard to steel and silica dust in the close vicinity of grindstones it is desirable to arrange hoods so as to intercept the flight of the particles, and it appears also probable, and is borne out by some experiments which we have made, that by a suitable arrangement of the hoods, the air flung off centrifugally by the grindstone as it rotates may be utilised to aid the blast. This principle, I believe, is not a new one, and, indeed, it is so obvious that it must have been thought of, but it would be very instructive if some of the firms engaged in the manufacture or use of grindstones would experiment in this direction.

H. CUNYNGHAME.

GENERAL NOTES.

BRITISH TRADE WITH SHANGHAI.—Conditions are changing in the business life of Shanghai, more rapidly perhaps than in any other part of the Far East. Continental and American firms are entering the field and pushing their wares with energy and aptitude. Large sums have recently been spent by Manchester firms in sending travellers to Shanghai, but they do not seem to make much headway. Commenting upon the position in his report upon the trade of Shanghai (Cd. 3283), Mr. Archibald Rose, of His Majesty's Consular Service, says that, in his opinion, young and energetic firms on the spot, who have a knowledge of their business and their customers, and who are willing to do pioneer work, are likely to prove most successful in meeting new demands and introducing new goods. The keen competition now springing up in Shanghai makes it necessary for the man on the spot to watch the markets and discover every possible opening for new products. "The first flush of Western education," writes Mr. Rose, "has given to the provincial populations a sudden desire for new things, and it has created a demand for which people are learning to cater. For the present such considerations may be of little interest to the wealthy piece-goods firms of Shanghai, who rely upon their old-established connections, and who are able to trust to their large wholesale transactions with the influential native merchants established here, who are moreover on firm ground, owing to their command of an international credit which still seems distant from the purely Chinese undertakings. At the same time there is in China a vast field of new activity for the British business man who is willing to work hard in understanding his subject."

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

GOLD MINING AND GOLD PRODUCTION.

BY PROF. JOHN WALTER GREGORY, D.Sc., F.R.S., F.G.S.

Lecture I.—Delivered January 28, 1907

I.—ALLUVIAL GOLD MINES.

Mining is the art of obtaining minerals and ores from the earth, and the best mining is that which does its work at the minimum of cost and with the maximum of profit. The gold miner uses many of the methods employed in mining for commoner materials, but he adapts them to suit his particular difficulties, and adopts many special contrivances of his own. The distribution of gold in nature is governed by its special properties, and they also determine the methods by which it can be sought and won. Thus, the reluctance of gold to enter into combination renders even the smallest grains of it almost indestructible, for they neither rust nor dissolve appreciably in any common solvent. The brilliant colour, which gives gold its decorative value, causes minute specks of it to be readily visible. Its unequalled malleability enables grains to be hammered out into broad flakes, which are conspicuous out of all proportion to their bulk. The relative scarcity of gold, which makes it a suitable standard of value, leads men to mine it in the remotest and most inaccessible corners of the globe, and enables them sometimes to earn a profit by extracting it from deposits, which contain only one part of gold in over 200 million parts by volume of earth. This remarkable feat is possible only owing to the exceptional heaviness of gold, which causes its natural concentration on river beds and allows its easy collection in miners' sluices.

THE SOURCE OF GOLD.

All the gold that is accessible to us must have come from one of two sources—the sea or the igneous rocks of the earth's crust. Sea water contains a small trace of gold; and if the vast volume of sea water has in solution even a very minute proportion of the metal, the oceans must hold a quantity which, if it could all be extracted, would render gold a drug upon the market. The prospects of extracting gold from sea water as a commercial process are not hopeful. Liversidge estimates the amount at about a grain of gold to the ton of sea water, but, according to Don, the sea contains only ·07 grain per ton, or about 1-100th of the amount which the waste waters of many cyanide plants are allowed to carry away in solution.

So far from the sea being the primary source of gold, there is no well-established case in which the gold found in the rocks has been deposited in them by precipitation from the sea. Whatever gold there may be in sea water has probably been obtained by the solution of gold grains upon the shore, and it is, therefore, secondary and not primary in origin.

Hence we are driven to seek the original source of gold in the only alternative—the interior of the earth. The one fact certainly known about the interior of our earth is that it is much heavier than the rocks which compose its outer crust or shell. This view was advanced as an hypothesis by Isaac Newton, and it was demonstrated in 1774, when Maskelyne, using Mount Schiehallion, in Perthshire, as his weight, and a plumb line as his balance, actually weighed the whole earth. He found that its density is nearly twice as great as that of the rocks which form its crust; and later measurements have proved that the internal mass of the earth is even heavier than Maskelyne thought. The central mass of the earth is so heavy that Posepny appropriately named it the "barysphere," or heavy sphere. The

simplest explanation of the great weight of the barysphere is that it is loaded with heavy metals; and, according to the calculations by Hutton, in 1779, based on Maskelyne's observations, the heavy "metalline part," as Hutton called it, must occupy $\frac{20}{31}$, or nearly two-thirds of the diameter of the earth. Direct evidence in support of the concentration of metals in the interior is supplied by the fact that the primary ores of gold occur either in those old rocks which have once been deepest below the surface, or in localities connected with the interior by fractures in the crust or by volcanic action. Alluvial gold may be found in rocks of any age, from Archean times to deposits that are still forming. But the majority of the gold-bearing lodes of the world, as in Russia, India, South Africa, Brazil, and many of the gold-fields of North America and Australia, occur in very ancient rocks that have been at one time deeply buried beneath the surface, or were formed nearer the earth's barysphere than later deposits.

The gold found in veins in the younger rocks occurs chiefly along great fractures through the crust, as in the Sierra Nevada of California, or else in association with igneous rocks that have been forced up from below, such as the volcanic neck of Cripple Creek, in Colorado, and the intrusive igneous rocks of the Thames Goldfield, in New Zealand. In both cases the gold in the younger veins has, doubtless, been brought up from below by vapours or solutions escaping from the deep, intensely-heated barysphere.

Alluvial Gold.

Gold ores may be divided into two groups—primary ores, wherein the gold has been introduced in solution, such as veins, lodes, or masses; and secondary ores, into which the gold has been carried in fragments, derived from primary ores by the mechanical action of wind or water. (Fig. 1). Alluvial gold is derived from the destruction of primary gold-bearing deposits. The light, earthy material in the lodes is swept away by wind or stream; but gold, being nearly eight times as heavy as its usual companion, quartz (the specific gravity of gold being 19·33 and that of quartz 2·6), does not travel far. It comes to rest all the sooner owing to its softness, for the angular grains are worn into rounded pellets, and the flakes are rolled into cylinders, which from their size and shape are often called "mouse droppings;" and the gold, therefore, offers little surface to the water.

Fig. 1.

The Kum-Tow Gold Nugget, from the Rheola Goldfield in North-Western Victoria. From a photograph issued by the Mine Department, Victoria. The nugget was discovered on April 17, 1871, at the depth of 12½ feet. Gross weight, 795 oz. 19 dwt.; value £2,872.

In arid regions, or in positions where the decomposed lodes are exposed only to the action of wind and occasional rain, the gold remains in rough particles, close beside the lode from which it fell. It is known as "shed

gold," and may be recognised by the angularity and raggedness of the grains. Where, on the other hand, the gold is carried along by a stream, it is rolled into the rounded forms characteristic of water-worn gold.

Gold Washing and Sluicing.

The first stage in the history of a gold-field is generally the discovery of its alluvial gold. There is a "rush" to the locality; the miners peg out their claims, according to the regulations of the local law, and they dig shallow pits into the gravel or coarse sand, in which alluvial gold generally occurs.

The simplest method of extracting the gold is to wash the "dirt," as it is called, in a tin dish or pan. An ordinary tin dish when well heaped up holds 20 or 25 pounds of earth, and there are usually about from 150 to 180 dishfulls to the cubic yard. The material is stirred with water, the washed pebbles are picked out by hand, and by a swirling motion of the water the earth is washed away and the heavy metallic particles left in the dish. The gold is in the form of grains and thin specks known as "colors;" on the average about 35 colors weigh one grain. If the gold collected from one dishfull weighs one grain the material is worth about four dwt. to the ton, or six dwt. to the cubic yard.

The tin dish is only serviceable in prospecting, in working small pockets of very rich ore, or in extracting gold which has been concentrated by some other process, such as sweeping the surface of the bed rock exposed by the removal of the overlying gold-bearing gravels.

Poorer ores must be handled in larger quantities, in some such machine as the miner's cradle. It is a box about three or four feet long, one and a half or two feet wide and deep. The top of the box consists of a sieve into which the earth is shovelled, water is poured on to the earth from a can, and the material is washed by swinging the machine to and fro on its rockers. The fine material falls through the sieve on to a sloping piece of wood covered with plush, on the rough hairy surface of which the gold is collected, while the lighter mud and sand are swept away by the current. This machine, a Californian invention, is very efficient in the recovery of fine gold. Poorer material may be treated by being washed by a stream of water down a long trough or sluice-box, of which the modern form is popularly known as a "long tom." The long tom consists of a trough, usually about 12 feet long and 20 inches wide, with a slope of about one inch in a foot; the floor of the lower part of this trough is crossed by a series of ridges which catch the gold.

The long tom is suited to the requirements of a small party of working miners; for operations on a larger scale the same method is used, but there is a longer "sluice." It consists of a very long trough or channel, composed of a series of wooden sluice boxes, like the long tom, or of a trench cut in a rock, or of both. Thus the Colombian Hydraulic Company used a sluice composed of 2,839 feet of boxes and 502 feet of trench cut in rock. Such long sluices requires hundreds of sluice boxes, placed end to end, they are sometimes about a mile in length. The usual grade is a fall of about 1 in 24.

If the gold-bearing material is so compact that it does not readily fall to pieces in water, then it has to be crushed before it can be washed; it may be broken by being pounded in a tub of water with a dolly; or it may be broken up on a larger scale in a puddling machine, in which the power is supplied by a horse, water-power, or steam. This process of puddling may be used where water is so scarce that it cannot be allowed to run freely away as in sluicing.

In these various contrivances the essential procedure is the same. The material is stirred up with water, which washes away the light earth, while the heavy gold is caught on the floor against ridges of wood or angle iron, known as "riffles," or upon rough surfaces such as blankets, or by means of mercury, with which gold readily combines as an amalgam.

The grade of ore which can be worked by these devices depends upon the scale on which the material can be handled. The greatest achievement in mining on these lines is the system of hydraulic sluicing, which we owe to California. The gold-bearing gravels occur there on the flanks of the Sierra Nevada, so water can be impounded in reservoirs at a higher level and brought to the mine by a ditch or race. The water falls down a steel or iron pipe (coated inside with asphalte to prevent it rusting) to the level of the gold-bearing deposits, against which it is directed by a huge nozzle, usually called a "Giant." The water leaps from the nozzle and falls with such force on the cliff that it tears away the materials like a steam navvy. For example, at Fresno, in California, the pipe line from the open race to the nozzle was 4,020 feet long, and had a

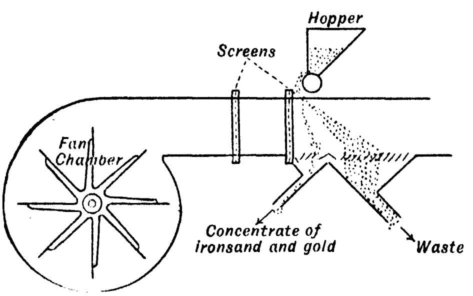
fall of 1,411 feet. The weight of the column of water was 317 tons, so the pipe increased in thickness from ¼ inch steel at the top to ⅝ inch steel at the bottom. The water was discharged through a nozzle 1½ inch in diameter, with a thrust of 93 tons, at a speed of 100 miles per hour.

Such a powerful jet digs into the base of the cliff and undermines it; the gravel falls in huge masses which are broken up by the play of water, and the loose material is swept away down the sluice. Large stones, fifteen pounds in weight, are carried along like corks, while the heavy grains of gold rest against ridges, or are caught by mercury in depressions on the floor of the sluice.

This system of mining is cheap where abundant water-power is available. The water may have to be collected in some distant valley and brought to the mine by a long and costly aqueduct. But where water and a good fall are locally available the equipment is inexpensive, the power costs practically nothing, and little labour is required. In such cases hydraulic mining has been profitably employed upon deposits, which yield only one part of in gold every sixteen million parts by weight of earth.

Modifications in the system of hydraulic sluicing are required under different geographical conditions. Thus in the famous Arctic goldfield of the Klondyke the ground, being permanently frozen, has to be thawed by fires before the gravels can be disintegrated and washed. A very different method of

FIG. 2.



THE EDISON DRY CONCENTRATOR (after Chapman).

alluvial mining is necessary in arid tropical regions. Hydraulic mining is impossible on the plains of Westralia, where water has often cost one shilling or even two shillings a gallon, and was far too expensive a luxury to use in gold washing. Hence the Westralian miners developed the system of dry blowing; gold-bearing earth is crumbled to powder and allowed to fall in a stream before a pair of bellows, which blows the light sand and clay aside, while the heavy gold falls vertically on to a tray. Edison's dry concentrator (Fig. 2) is a more elaborate machine of the same type. It is used, *e.g.*, in the Golden Mountain of New Mexico; the blast is produced by a powerful fan, and acts on the sand, falling across a tube; the sand is blown along the tube while the gold and black iron-sand fall into a separate hopper. The concentrate is then allowed to fall like solid rain before some powerful electric magnets; they attract the black iron sand and the dry separation of the gold is thus completed magnetically.

In other gold fields, sluicing is prevented by the presence of too much water. River beds are often auriferous; and the simplest method of obtaining this material is to build a wing dam, forming a dock in the river; the dock can be emptied by a Californian pump, driven by the river current, and the material on the bed then mined and treated.

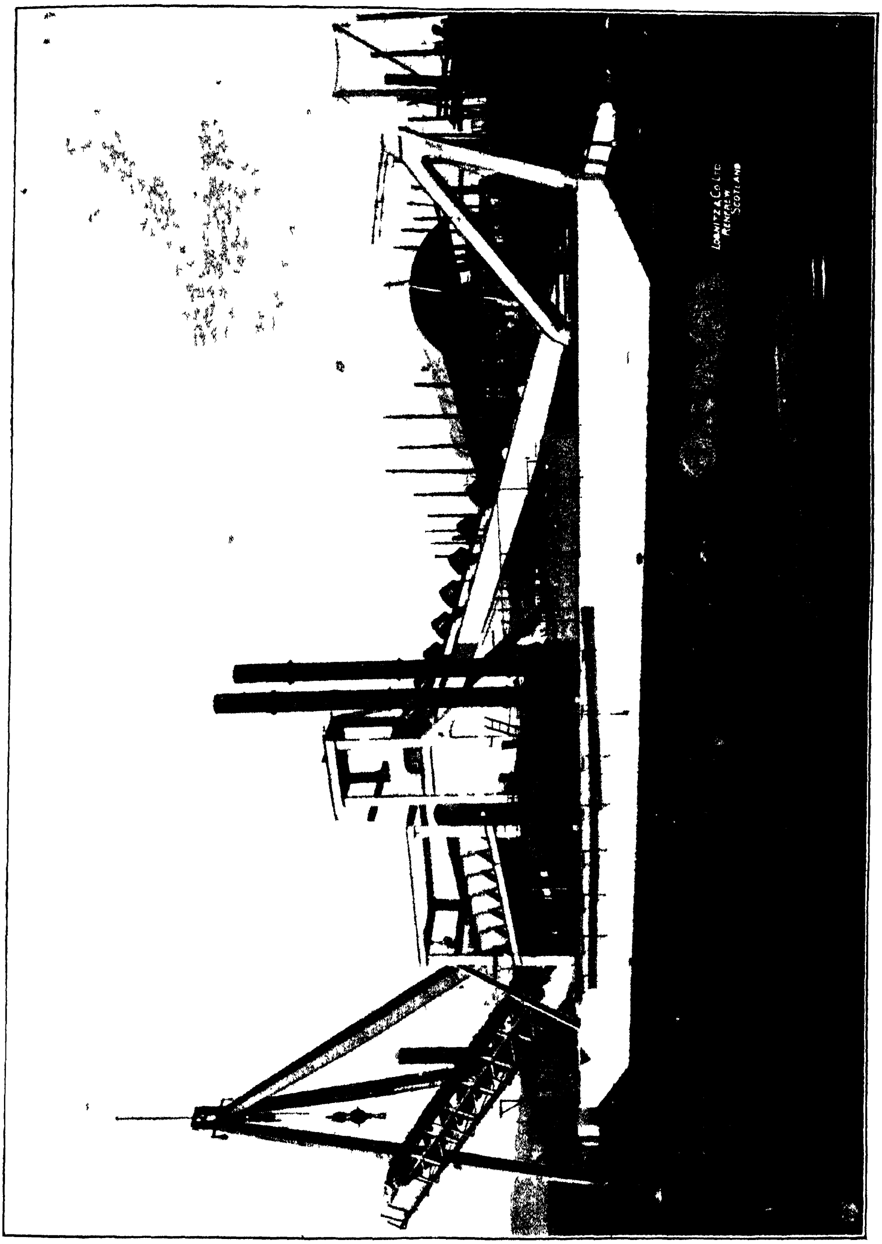
A second method is to divert the river from its course by cutting a canal or tunnel through a spur of land, and thus draining a whole reach or meander of the river. This work may be expensive; but it leaves bare a considerable area of river bed. This method is at least as old as Job, who tells us that the miner bindeth the rivers that they flow not. One of the best known modern cases was the binding of the Feather River, in California, so that it no longer flowed through the loop of its channel occupied by the Cape Claim, near Oroville; the miners recovered £120,000 of gold before the river suddenly retook possession of its bed.

GOLD DREDGING.

During the past twenty years, a new and still more effective method of working gold-bearing river beds has been developed owing to the inventive ingenuity of the miners in the Dominion of New Zealand. Many of the rivers in the South Island of New Zealand could not be conveniently diverted or worked by wing-dams; so the miners scooped up the gravels beneath these rivers in a small trawl or "spoon dredge," consisting of a leather bag, armed with a steel rim or lip. It was fastened to a pole, and dragged over the river bed. In 1881 it occurred to Mr. McQueen, of Dunedin, "the father of gold-dredging," that the bucket-dredge, well known from its use in deepening rivers and harbours, might be used to replace

this crude contrivance The "Dunedin Gold Steam-Dredging Company, Limited," was founded, a dredge built, and successfully employed, in 1882, on the Clutha River, in New Zealand Its success marks the real foundation of the great industry of gold dredging

FIG 3

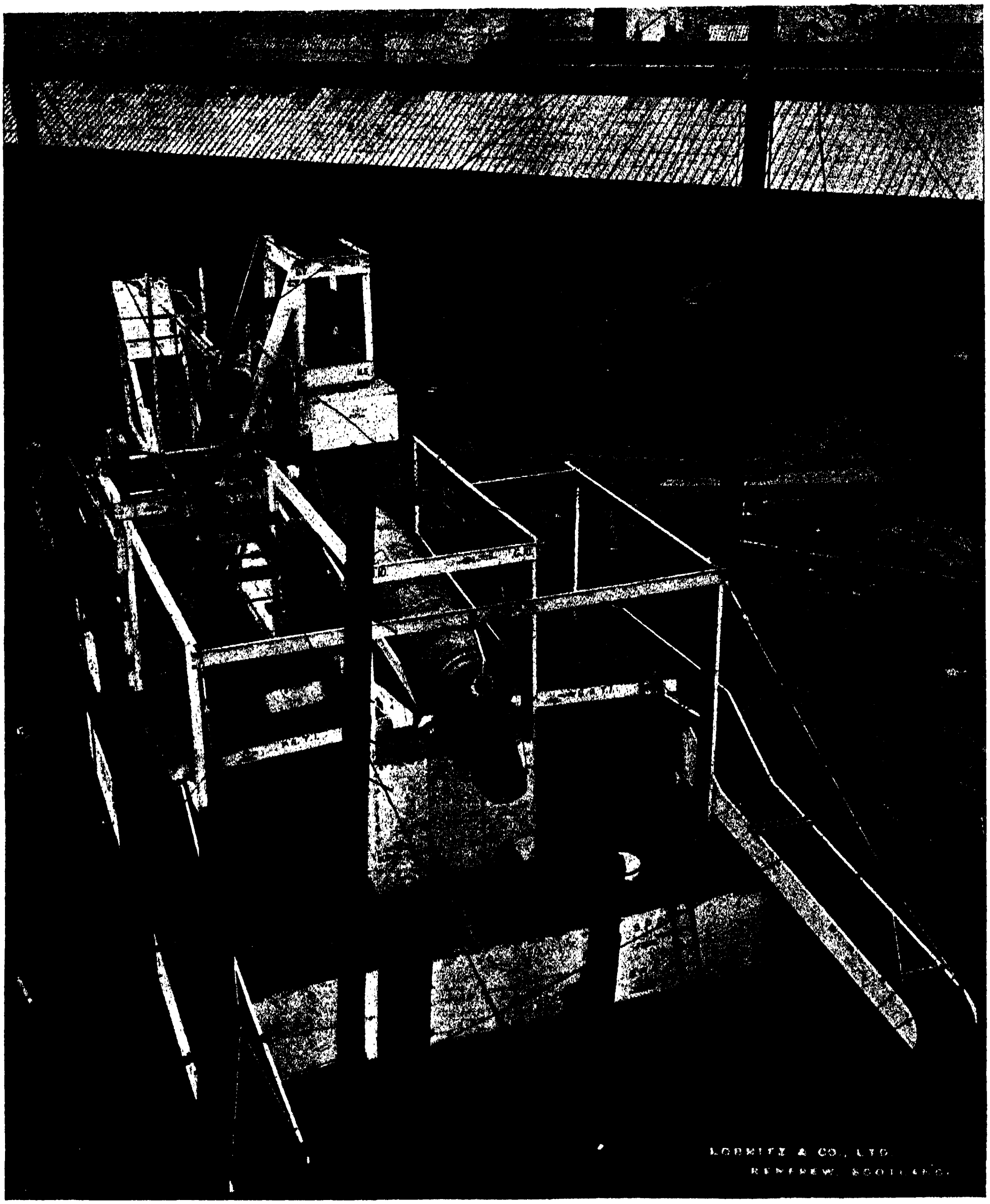


A GOLD-DREDGE (from a photograph lent by Messrs Lobnitz & Co, Renfrew) The chain of buckets and its boom are seen over the right-hand half of the dredge The gold separating apparatus is raised to the left of the boilers. The tailings elevator is raised projecting from the stern of the dredge beneath the crane

The simplest, and as a rule the most economical type of dredge, consists of a barge, from which a chain of buckets on a continuous, jointed ladder is forced against the river bed by being hauled round the end of a boom, the buckets dig up the gravel, lift it above the deck and discharge it on to a sloping platform of bars—a grizzly The grizzly separates the

large boulders which slide down it on to the deck of the dredge, or fall into a boat, from which they can be dumped safely out of the way. The finer material passes between the bars of the grizzly into a cylindrical revolving screen, known from its shape, as a "trommel," the German word for a drum. The pebbles run in a stream down the inside of the screen; while the fine material falls through the holes on to the washing tables; the fine clay floats away in the water; the sand is washed down the sluice boxes, where the gold is caught against obstacles, or in the hairs of the baize, coco-nut matting, plush or blankets on the

FIG. 4.



PART OF THE SEPARATING AND GOLD SAVING APPARATUS OF A DREDGE. (From a photograph lent by Messrs. Lobnitz and Co.).—The trommel is seen in the centre, and the gold saving tables project forward on each side of the front of the photograph.

floor of the boxes. The barren waste material or "tailings" were at first dropped over the stern of the dredge, whence it soon worked forward and was redredged. The re-working of the material was such a ruinous waste of power, that the river could only be dredged in patches; but after several attempts a successful tailings elevator was invented in New Zealand in 1894, and after that date the dredging industry made rapid progress. The usual forms of tailings elevator consists either of a chain of buckets or of a revolving belt, which raises the waste material and drops it behind the dredge in a heap on the shore. Another form is the Payne-Peck elevator, a centrifugal machine that spits out the waste material and throws it on to the bank. The advantage of this contrivance is that it obviates the need of so heavy and expensive a dredge as is required to balance a large elevator.

The use of dredges is not confined to the actual river courses for which they were at first designed; they mine alluvial flats and flood plains beside rivers with equal success. A pit is dug and flooded, and the dredge floated in it. The dredge not only hauls up the material on the floor of the pit, but tears away the sides; it gnaws its way through an alluvial plain, filling up its track behind it with the waste material.

The second type of dredge, the suction dredge, works by a centrifugal pump instead of by buckets. It is really a gravel pump, which pumps up gravel instead of water. It may be used in places where the bucket dredge will not work; thus on a hard, rocky river bottom the gold may rest in crevices, from which the bucket dredge could not collect it, unless the bed rock has been shattered by blasting, so that the rock can be raised by the buckets. A suction dredge, however, can suck the bed rock clean. Suction dredges are mainly of value for use on alluvial flats, where the bed rock is hard and irregular. In such positions the dredge rests on the ground; a hole is dug before it down to bed rock; the adjacent gravel is washed into this hole by jets of water as in hydraulic sluicing; the gravel is sucked up by the pump and discharged over the gold-saving tables or down a long tail race, When the ground has been worked from the front of the dredge the hole is filled with water; the dredge is floated into a new position and the process repeated as before.

Dredging can be applied to any gold-bearing deposits which lie in comparatively level sheets either beneath or beside a river or upon a sea beach. Much of the success of gold dredging is due to the certainty with which the ground can be sampled, and provided the prospecting work is properly done and a dredge is selected suitable to the local conditions, this type of gold-mining appears to be unusually free from financial risk. The method of prospecting must vary with the local conditions; on a wide alluvial flat from one to four drill-holes in every ten acres may be sufficient. The gravel or sand is raised by a suction-pump from the bottom of the drill hole, and the gold carefully panned from the wash.

Gold dredges are successful because of the marvellous economy with which they handle great quantities of material. Some suction dredges which I once visited at Yackandandah, in Victoria, were earning a profit from ground that had been worked over four times by whites, and abandoned as useless by Chinese. Under favourable conditions a dredge will haul a cubic yard of earth from a river bed, sort it, wash it, and extract its gold for twopence, and sometimes even for less. The Vaughan bucket dredge at Castlemaine, during 1905, worked at a cost of 1½d. per cubic yard, and paid dividends by working deposits which yielded only ·96 grain of gold per cubic yard. According to Verschoyle, there are cases in New Zealand in which the work has been done for under one penny a cubic yard, or three farthings a ton. Hence dredges may earn a handsome profit with a recovery of two grains, or fourpence worth of gold out of every cubic yard of gravel. The average yield of all the bucket dredges in Victoria in 1905, was 2·04 grains, or four pennyworth of gold per cubic yard, or three pennyworth per ton. The Victorian suction dredges in the same year recovered an average of 3·12 grains.

Deep Leads.

Gold dredging is an invention that has enriched most gold-mining countries. Another system of alluvial mining is of more limited application, but it happens to be of especial interest at the present time. It is the working of the deep leads of Australia. A deep lead, according to the Mines Act of Victoria, 1898, is, "any watercourse or gutter below the surface of the earth, containing alluvial deposits at a depth of not less than 100 feet from such surface."

The Australian mining industry began in 1851, and its first great success was the discovery of the rich alluvial gravels of Golden

Point, Ballarat, on 24th August, 1851. The gravels there were exceptionally rich: for their gold had come from very rich lodes, and it had been twice concentrated by river action. The fame of the field was increased by the discovery of its gold nuggets, or masses of almost solid gold lying in the alluvial beds. The largest known nugget, the Welcome Stranger, which contained 190 lbs. of gold, was found at Moliagul; but the second largest, the Welcome Nugget, was found at Ballarat in 1858; it weighed 184 lbs. 9 oz. 16 dwt., and was sold for £10,000. These sensational nuggets, even more than the richness of the gravel in bulk, made Ballarat the most attractive of the early Victorian goldfields.

Some of the deposits first worked at Ballarat lay on the beds of existing streams; but the richest material, including the gravel of Golden Point, was in old river beds known as "leads." The miners followed these leads, till their work was stopped against a cliff of the igneous rock, which formed the plateau of Ballarat West. It was feared that this igneous rock had completely destroyed the lower courses of the old rivers. This rock wall repelled the army of miners who were camped on the plain beneath as successfully as the walls of Sebastopol were then resisting the allied armies in the Crimea. Hence the plateau received its name of Sebastopol.

It was predicted by a Mr. Thomson, one of the staff of the Port Philip Mining Company, that the leads would be found to continue under the plateau of igneous rock; but the miners would not believe it, and insisted that the leads must pass southward along the face of the plateau down the present valley of the Yarrowee Creek. No traces, however, of the old river, in this direction could be found.

At length, in August, 1854, some miners at the White Flat Rush, at Creswick, a goldfield ten miles north of Ballarat, who were faced by the same difficulty, drove a tunnel straight at the face of the basalt. They discovered that instead of the rock being a thick, deep-seated mass like a granite, it was only a thin, superficial sheet like a lava, and beneath this rock the gravels were continued and safely preserved. This enterprise began the system of deep lead mining.

When the news reached Ballarat, the miners renewed the attack on their Sebastopol; they mined beneath its wall, traced the Frenchman's Lead beyond it, and thus began the mining of the buried gravels of Ballarat West. As they worked away from the edge of the plateau, they found it more convenient to reach their work by digging a shaft down through the basalt to avoid the great length of tunnel that would otherwise be necessary. The first shaft was put down in October, 1855. In the following year (June, 1856), the miners tried to economise work, by prospecting ahead of the actual mining. For this purpose they began the first of the innumerable boreholes which have been put down to discover the course of the buried leads.

Deep lead mining was comparatively easy where first developed at Creswick and Ballarat, for the general course of the lead was followed inward from its outcrop, and the water in the deposits could be removed without undue difficulty. The success of deep alluvial mining at Ballarat led men to consider the possibility of discovering leads beneath the other basalt plains of Victoria.

Large tracts of the State of Victoria are occupied by plains, and deeply buried beneath them is an old land surface with its valleys, river channels, and hills. In northern Victoria the plains are formed chiefly by the thick wide-spread silts of the Murray basin; in southern Victoria the most important plains are due to sheets of basalt which have flowed from numerous volcanic vents. At Ballarat the basalt has smothered the old divide between the rivers that formerly flowed directly southward into the Southern Ocean, and those that were tributaries to the Murray. The basalt plateau of Ballarat projects in long narrow bands, which extend for 50 miles to the north. These lava bands stand up above the general level of the country as plateaus, while the existing rivers flow through young valleys cut into the soft rocks on the edges of the lava.

The idea occurred to some members of the staff of the Geological Survey of Victoria that these lava plateaus represented ancient river valleys, that had been filled by basalt. After the close of the volcanic eruptions, the rivers were forced to cut new channels along the edges of the lava flows; hence in time the banks of the old valleys were worn down, while the floors of the valleys have been left upraised owing to the resistance of the hard basalts that filled them. This theory offered the only reasonable explanation of the distribution of these lava bands; and, if it were true, the old river beds, with their gold-bearing gravels, must still lie buried beneath the lava flows. The discovery at White Flat Rush in 1854 proved that the rich shallow leads of the Creswick

Goldfield passed beneath the edge of the basalt sheet that flooded the old valley of the Loddon.

Krause's map of the Creswick Goldfield, published by the Geological Survey of Victoria in 1870, showed that the former course of the Loddon could be fixed between fairly narrow limits. The site of the old river banks is marked by the outcrop of the slates and sandstones on either side. The first practical suggestion for the search for the old leads was made in a report by Mr. R. Murray, then the acting Government geologist for Victoria. He reported (30th September, 1878) that from the geological survey of the country to the north of Creswick,

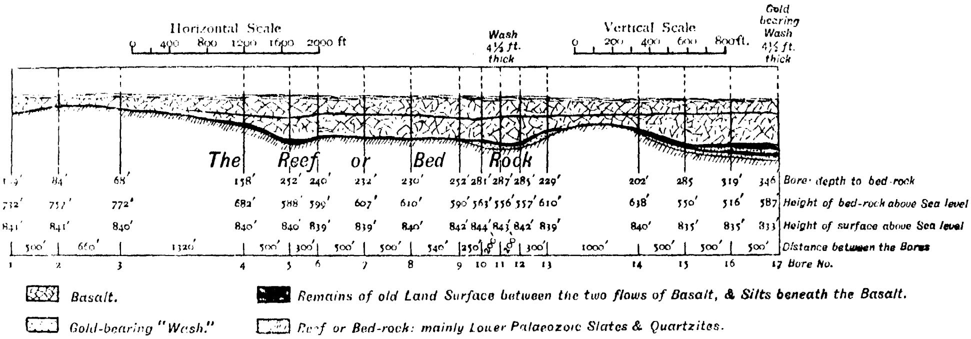
"It appears beyond a doubt that two main deep lead systems, fed by tributaries, pass eastward of Clunes, and unite to the north-east, between Eglinton Swamp and Glengower. The eastern of these two systems embraces the rich leads now being worked northward from Creswick and Kingston, probably fed by others, among which may be the extension of the Rocky lead. Of the western system little or nothing is known Its existence is indicated by the basalt covering the country between the schistose rocks exposed at Clunes and those which form the western wall of the Creswick leads."*

Murray pointed out in his map the outlet through which the old river must have passed, and he proposed to put down a bore half way across this gap to discover approximately the probable depth and position of the lead.

This prediction has been amply justified by the results. The leads have been discovered and mined both in their upper reaches near the margin of the lava sheet, and lower down their course far out into the basalt plains.

In mining part of a deep lead it is first necessary to determine its exact position and depth. There is no indication on the surface of the site of the old river channel; the ground may be a bare level plain which is quite independent of the undulations of the former land. A line of bores is put down through the basalts and underlying drifts to the bed rock, and from the bore records a section is drawn showing the contours of the buried land surface. (Fig. 5). This section shows the position of the river channel or "gutter," as well as its depth and width and the thickness of its gravels. The material brought up from the bores also shows whether the drifts contain gold, but the samples collected from the bores are so disturbed that they may not give reliable evidence as to the gold-value of the drifts.

FIG. 5.



SECTION SHOWING RESULTS OF 17 BORES in the Parish of Moolort, on the basalt plateau of the Loddon Valley, made to discover the buried leads. (Reduced from the Section by Stanley Hunter: 1898.)

The bores also give useful evidence as to the nature of the rocks beneath the lead. For coarse gold usually travels so short a distance that a lead is not likely to be rich at a point far from a source of gold. Where the old river crossed and recrossed a belt of gold-bearing lodes its gravels may be expected to be rich; but if it be crossing rocks that contain no gold, then the lead will doubtless be poor.

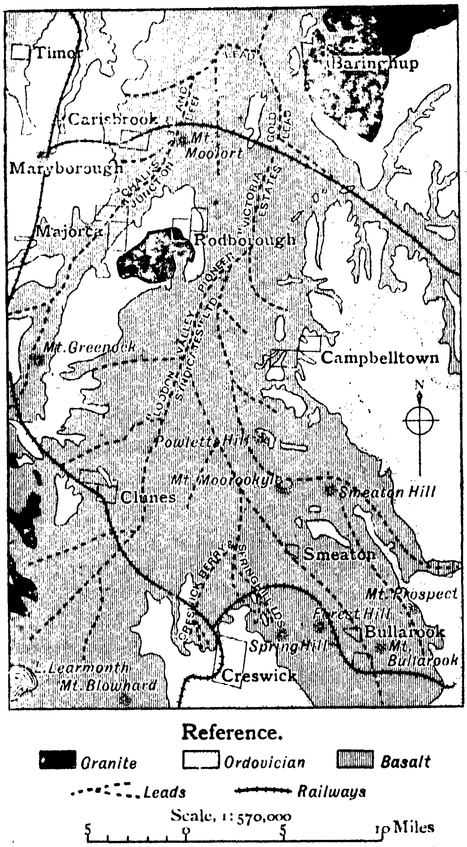
By numerous lines of costly borings, most of which have been made by the Government of Victoria, the distribution of many of the deep leads of that State has been determined. The old valleys have been discovered buried beneath the silts of the Murray at Chiltern and Rutherglen, and under the basalts of the Loddon valley, the Ballarat plateau, and other districts of Victoria. The Loddon leads are the longest and the greatest; and as the rivers there crossed a belt containing many gold-bearing lodes, their gravels are often rich in gold. The position of the leads has been determined in so many places, that the general

* Progress Report Geol. Surv. Vict., No. VI., 1880, p. 48.

course of the old Loddon River and its chief tributaries has been discovered; and it can be represented on a map like an ordinary superficial river (Fig. 6); but it must be remembered that this river is sometimes buried under 500 feet of lava.

The course of the leads having been determined, the engineer proceeds to drain them.

FIG. 6.



SKETCH MAP OF THE DEEP LEADS BENEATH THE BASALT PLATEAUS OF THE LODDON VALLEY, VICTORIA. (After Stanley Hunter.)

This is often a long and costly business; for the beds are water-logged, and their own water has to be removed; and while this water is being pumped out of the lead more flows in. It may come from two sources—rain water which runs in from the sides, and deep-seated plutonic water, which is recognisable by its higher temperature. The pumping plant has, therefore, to lift all this incoming water before it begins its main work of reducing the old accumulations in the drifts.

Mines have pumped a million gallons a day for seven years before being able to mine any of their gold-bearing material. The Great Southern Company at Rutherglen pumped two million gallons a day for five years. During recent years the necessity of having such powerful pumps that the accumulation of water can be rapidly dealt with, has been recognised; for if a lead can be drained in one year instead of seven, the pumping of the six years inflow is saved; and if the pumps can only keep pace with the incoming water the mine might go on pumping for ever. Quick pumping is, therefore, economical; and acting on this principle the Loddon Valley Goldfields has erected a pumping plant capable of lifting 6,000,000 gallons of water a day; and that mine and its neighbour, the Victorian Deep Leads, pumped in January, 1906, no less than 250,000,000 gallons of water in one month.

When once the gravels have been drained they are so easily and cheaply worked, that they often give returns which well repay the cost of pumping. The Madame Berry Mine, at the head of the Berry Lead, on a called-up capital of £15,000, raised no less than £1,588,515 of gold; and paid over £900,000 in dividends and royalty.

There are two chief methods of deep-lead mining; the method selected depends largely on the hardness of the rocks that have buried the lead.

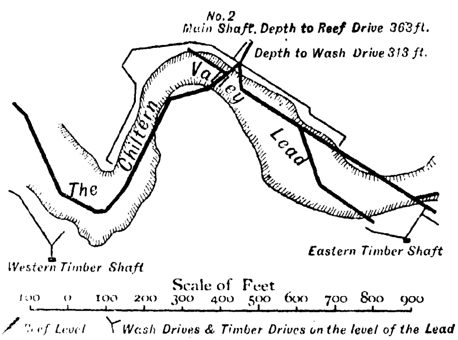
In both systems the first operation is to put down a shaft. A site is chosen where, if possible, the solid bed-rock is exposed at the surface or it is known that the shaft will go at once from basalt into bed-rock without the risk of passing through quicksands. Where, however, shafts have the one misfortune to encounter soft water-logged beds, the difficulties may be overcome by making the loose ground solid by freezing it until the shaft has been made and lined.

The main shaft is carried down into the bed-rock to a depth well below the deepest point on the lead. A drive is then made from a point a little above the bottom of the shaft through the bed-rock, or "reef"; this drive is therefore known as the "reef drive." It is carried under the lead, and bores—3-inch pipes—are then pushed up from it into the gold-bearing beds; their water rushes through the bore-holes into the drive, and flows along it to the pump chamber at the foot of the shaft. The number of bores opened is determined by the capacity of the pumps. As soon as the ground is sufficiently drained a rise is put up from the reef drive into

the lead. The gravel, known as the "wash," is then dug out, and dropped down shoots into the reef drive, where it is run to the main shaft and hauled to the surface.

In the second plan of working a deep lead mine, drives are made from the shaft at two levels; the lower one—the "reef drive"—is the main permanent drive of the mine, and is used for hauling and ventilation. (Fig. 7). The upper drive runs up at once into the wash, and is known as the "wash drive"; it helps to drain the lead in its neighbourhood, and from it cross drives are made to the edge of the lead; from the end of each cross-drive, a lateral drive is pushed forward along the edge of the lead. The ground is therefore blocked out by three longitudinal drives in the wash; the

FIG. 7.



PLAN OF PART OF THE CHILTERN VALLEY GOLD MINE, in the Chiltern Goldfield, Victoria. (Reduced from a Survey by Stanley Hunter.)

wash is dug out and dropped into trucks on the reef drive, which follows behind the work in the wash, thus avoiding the waste of unnecessary branches of the expensive reef drive.

In calculating working costs in these lead-mines, the unit is not the ton but the square fathom; for most of the gold is in the bottom of the wash, and as much gold may be got from wash three feet thick as from wash six feet thick.

The extraction of the gold is done by simple puddling. The process consists of washing the material, sorting out the cleaned boulders and stones, and then collecting the gold from the fine sediment by the use of blankets, riffles, or mercury. As the mines are situated on level plains where there is no natural fall, the puddling machinery is erected on platforms high above the mouth of the shaft. The material then falls through the gold-separating apparatus by its own weight, and the waste can be run on to dumps across a raised tramway. A deep lead mine can be recognised from a distance by its high poppet legs, and by the huge piles of washed quartz boulders and pebbles extracted from the wash.

SCOPE OF ALLUVIAL MINING AND CHOICE OF METHOD.

Some years ago the idea was prevalent that alluvial mining had done its work, and that it would soon be numbered among the extinct industries; for although new finds, such as those which have been made at Klondyke, in Siberia and South America might start fresh local centres, the room for such discoveries was being rapidly narrowed. But the combined work of the engineer and the geologist has given fresh impulse to alluvial mining. The field of its operations is steadily growing with the increasing capacity of modern mining methods. The three main systems of alluvial mining are each suitable to special areas. Deep lead mining is the most restricted geographically, and is at present confined to Australia; but it will no doubt be found applicable in some African localities.

Hydraulic mining requires an abundant water supply, a good fall, and thick gold-bearing deposits. So it is suited to mountainous country with an ample rainfall, where gold-bearing beds occur on the sides of deep valleys; and it can be most economically applied to deposits from 150 to 200 feet in thickness. If the beds are thinner, then much time is lost in continually extending the pipes and the sluices to reach the fresh ground. If the beds are thicker the face falls away in dangerous and unmanageable masses, and the mine may have to be worked in two benches.

Dredging offers the widest possibilities, for it may be applied to any level sheets of gold-bearing alluvium. It may be used on any sea beaches, river beds and riverine plains where the alluvium is not too deep for the tailings elevator to lift the refuse on to the bank. The use of dredges has also spread from Australasia to North America, Siberia, Servia, Burmah and West Africa, and they have been tried in South Africa. We need not accept the confident prediction that the dredges will make so great a contribution to the gold yield of the world that they will have a revolutionary political influence, raising the prices of all other commodities by lowering the price of gold. But the supply of low grade material which the dredges can work is so vast and so widespread that they promise to extend in-

definitely the life of alluvial mining: all the gold-producing countries of the world are, or probably will be, indebted to the ingenuity of the New Zealand miners who have shown us how to collect gold from these low grade deposits, in which it would otherwise have lain beyond our reach.

THE CRICKET-BAT WILLOW.*

By W. J. Bean.

No question in connection with profitable tree-planting has aroused greater interest in recent years than that as to the kind of willow best adapted for the manufacture of cricket bats. It has only attained importance in recent times, because it is only lately that the supplies of the best "bat willow" have become seriously limited, and that prices have risen in proportion. At a sale of willow trees on Sir Walter Gilbey's estate at Sawbridgeworth, in February, 1906, the best "bat willow" realised prices estimated to be equivalent to about seven shillings per cubic foot. I have recently been informed by the agent of a large estate in Essex that he had declined the offer of £1,500 for the best 100 willows on the estate; and Mr. John Shaw, of the well-known firm of Shaw and Shrewsbury, of Nottingham, last winter offered £40 for a single tree. When it is remembered that trees have been known in favourable situation to reach a saleable size in twelve years (having in that period attained a girth of about 50 inches) these prices show that there is no timber so profitable at the present time as that of the cricket-bat willow. It is not surprising, therefore, that the attention of owners of land suitable for the growth of willows should have been attracted by this tree. As a matter of fact, a large number of willows have been planted during the last few years with a view to meeting the future demand; but we have it on the authority of Mr. Shaw, one of the largest buyers, as well as a leading expert, that not more than one-fourth of the trees that are being planted are the best cricket-bat willow.

The identity of the true "bat willow" has always been obscure. The cricket-bat maker recognises the tree best suited to his purpose with infallible certainty, but the characters on which he relies are not characters on which the botanist bases his distinctions. It is with a view to helping the planter to recognise the willow best suited for cricket bats, and to avoid the unsuitable ones, that the matter is now being taken up in the *Kew Bulletin*.

It has for some time been evident to us at Kew that there is more than one willow valuable for bat making, although, perhaps, not equally valuable

* Reprinted from the *Kew Bulletin*, No. 8, 1907. The original articles contain two plates, one of the best "close-bark" willow (*Salix alba*, var. *caerulea*) and one of the "open-bark" willow (*Salix fragilis*).

It has also been evident that whatever the best "bat willow" might be, it is not so much a species in its entirety as a variety or, perhaps, merely a local form. With a view to settling the identity of the true kind the Copped Hall Estate, near Epping, the property of Mr. Wythes, was visited in company with Mr. Shaw. Here a large quantity of "bat willows" are growing, and specimens were collected of the different sorts whose respective values for bat-making were certified by Mr. Shaw. They have since been botanically identified, and for assistance in this work we have to express our obligations to the Rev. E. F. Linton, M.A., the well-known authority on British willows. The expert knowledge of the cricket-bat manufacturer has, therefore, been joined to that of the botanist, and it now remains to put on record the conclusions at which we have arrived.

The "Open-Bark" Willow (*Salix fragilis*, L.).

The two commonest terms used in describing willows from the bat-maker's standpoint are "open-bark" and "close-bark." There is no difficulty or mystery about the "open-bark." It is the crack willow—the *Salix fragilis* of Linnæus—a common tree on the banks of the Thames near Kew. Although a useful timber in other respects, it is of very inferior merit for the making of cricket bats. It is, in fact, used only for the manufacture of cheap bats for children, such as are sold in toy shops, rather than by the genuine athletic outfitter. They are of a reddish colour. In connection with the present question, the "open-bark" or crack willow should only be known in order to be avoided.

Botanical characters of *Salix fragilis*.—A tree 80 to 90 feet high, with spreading branches; branches growing at angles of 60° to 90°. Leaves coarsely serrate, usually somewhat pubescent at first; pubescence deciduous. Stamens silky at extreme base only. Ovaries, in the commonest (probably unfertilised) state, almost subulate, but ovate-lanceolate in the fertilised condition, gradually narrowing to a distinct style; their pedicels ultimately three to four times the length of the nectary.

The Best "Close-Bark" Willow.

(*Salix alba*, L. *caerulea*, Syme [*S. caerulea*, Smith]).

The willow selected by Mr. Shaw as the very best one for bat-making is a tree of markedly pyramidal habit; it is female or seed-bearing, and it belongs to the bluish-leaved variety of the white willow. It is, therefore, a pyramidal form of *Salix alba*, var. *caerulea*. The bark is less rough than in *S. fragilis*, and the corrugations are less prominent, straighter, and more continuous up and down the trunk of the tree. The wood is white, and when it is being split does not part so easily as the "open-bark" does, but splinters a good deal. This splintering or tearing down the cleft is regarded as an evidence of good quality.

According to Mr. Shaw this particular tree is only

to be found at the present time in the counties of Essex, Hertford, and Suffolk. A few trees were at one time growing in Kent and Surrey, but it is his belief that the true "bat willow" is no longer to be obtained there. Neither Cambridgeshire nor Lincolnshire has it, nor does it exist (except for recent plantings) north of the Trent. This all goes to show that this willow is a local form, and that only those "sets" can be relied on which have been obtained from the right district. *Salix alba*, var. *caerulea*, is grown at Kew, where there are two fine specimens on banks of the lake. But although in character of leaf and fruit they are identical with the trees on the Copped Hall Estate, in habit they are quite different. The trunks have forked low, and the habit is more spreading. Although some of the Copped Hall trees are growing in hedgerows and have ample room for lateral development, their tapering pyramidal form is a most noticeable characteristic.

The pyramidal shape of the tree is associated with, and may in some measure be due to, a great vigour of growth. And it is reasonable to conclude that it this vigorous growth which gives to the timber those peculiar qualities which render it better adapted for cricket-bat making than any other variety of white willow. It is a remarkable fact that of all the hundreds of timbers now available from the tropical and temperate parts of the globe, the only tree yet known to produce a timber of the right quality is found in a few counties in England.

In regard to quality of timber for cricket bats, the typical *S. alba* appears to be intermediate between *S. alba*, var. *caerulea*, and *S. viridis* (v. below). A tree at Copped Hall was considered by Mr. Shaw to be of second rate, though of fairly good quality.

Botanical characters of *Salix alba*.—A tree 70 to 80 feet high, with ascending or erect branches growing at angles of from 30° to 45°. Leaves finely serrate, silky pubescent; pubescence permanent. Stamens more silky in the lower half than those of *S. fragilis*. Ovaries ovate-conic, abruptly obtuse, sessile or with the pedicels shorter than the nectary; style very short or absent.

S. alba, var. *caerulea*, differs from ordinary *S. alba* in the leaf being glabrescent and of a bluish green tint. The ovaries are identical.

Botanically there is no well-marked dividing line between *S. alba* and *S. alba*, var. *caerulea*, the two being united by intermediate forms. It is possible that the quality of timber improves as the tree approaches the latter.

Salix viridis, Fries.

There is another willow recognised by Mr. Shaw as a "close-bark," and of a useful quality, but still inferior to that of *Salix alba*, var. *caerulea*. Although it is not easy to put on paper the differences between the "open" bark of *S. fragilis* and the "close" bark of the true "bat willow" in such a way that they can be indubitably recognised, they are appreciated easily enough when seen in the field. But the differences between the "close" barks, although perfectly evident to the expert eye of Mr. Shaw, are by no means obvious to the uninitiated. Nor was it possible, after careful "coaching" to fix on any distinctive features in the bark as a help for future occasions. This, however, is only one more of those instances, common to pretty nearly every walk in life, where distinctions clear enough to the trained eye are quite hidden from the outsider.

But although the bark afforded no help in the differentiation of the two "close-barks," the trees were distinct enough in other respects. The habit of this second tree was more spreading than that of *S. alba*, var. *caerulea*; the leaf was smaller and not so blue; and the trees, being devoid of fruit, were presumably male. Mr. Linton considers this tree to be *Salix viridis* of Fries.

Salix viridis is a hybrid between *S. alba* and *S. fragilis*, and as these species frequently grow together, they have no doubt cross-bred very many times. It is quite probable also that the progeny have interbred with the parent species again. At any rate *Salix viridis* is a very variable tree, showing numerous intermediate gradations between the two parents—sometimes approaching *S. alba* and *S. alba*, var. *caerulea* so closely in leaf as to be indistinguishable from them, and sometimes showing very distinctly the influence of *S. fragilis*. Its advent into the cricket-bat willow question has created a good deal of confusion. A specimen approaching *S. alba*, var. *caerulea* may be described as good by the bat-making expert, whereas another approaching *S. fragilis* will be accounted inferior. Yet to the botanist both are *S. viridis*.

From the bat-maker's point of view the timber of *Salix viridis* is not so good as that of *S. alba*, var. *caerulea* because the wood is coarser and heavier. A bat made of good *S. viridis* timber would weigh about 2 lb. 7 oz. to the 2 lb. 4 oz. of *S. alba*, var. *caerulea*. The difference in market value is also so considerable as to be important to intending planters. Mr. Shaw stated that, for trees of equal size, buyers would give £10 for the *S. alba*, var. *caerulea*, but only £6 for the *S. viridis*.

With regard to the botanical characters of *Salix viridis*, it is difficult to give a concise description. It has already been explained that it is a hybrid between *S. alba* and *S. fragilis*, with which it has bred and interbred till it now forms an almost complete series of links between those two species. Therefore *S. viridis* in its various characters is more or less intermediate between the other two; this refers more especially to the angles at which the branches grow; the serration and pubescence of the leaf; the density of the flowers on the male catkins; the size of the ovaries, the length of their pedicels, and the distinctness of their styles. In some states, again, *S. viridis* has one set of organs, say leaves and twigs, resembling one parent, whilst the ovaries are almost identical with those of the other. In practice, as the late Dr. Buchanan White observed,

it requires the trained eye of the salicologist to detect and balance up the various characters that go to make *Salix viridis.*

SALIX RUSSELLIANA, Smith.

In connection with the "bat willow" question the name of *Salix Russelliana* frequently crops up, and is a source of considerable confusion. A correspondent of Kew complains that whilst one person tells him that *Salix Russelliana* is an excellent willow for bat-making, another says that it is quite worthless. The probable explanation of this is that "Russelliana" is a name that has been given to two different willows. Most commonly it has been applied to the "crack willow" (*S. fragilis*); in that connection, therefore, it indicates the very inferior willow for bat-making. But the name has also been given to the hybrid between *Salix alba* and *S. fragilis* which, as has already been explained, is itself a variable plant, but is often of good, although not the best, quality. The name "Russelliana" is now no longer used by the leading authorities on British willows, so that those interested in the cricket-bat willows would do well to discontinue its use.

POPULAR AND LOCAL NAMES.

Another source of confusion arises from the use of local names. So misleading are they, that they should be dispensed with altogether in connection with the present question, since it is hopeless now to find one popular name restricted to one particular willow. A name given to a particular species or variety may be in general use in one district, but it may be given to quite a different tree in another. In the course of consulting various works in connection with the cricket-bat willows the curious fact has been noticed that the terms "Huntingdon Willow" and "Leicestershire Willow" have both been applied to *Salix alba*, to *Salix alba*, var. *caerulea*, and to *Salix fragilis*.

PROPAGATION AND CULTIVATION.

It will have been gathered from what has been said that there is at the present time a brisk demand for young trees or "sets" of the true "bat willow." Enquiries are being continually addressed to Kew as to where they can be obtained, but we know of no one at the present time who is able and willing to supply them in quantity. It is of little use applying to the ordinary trade firms. With the best will and the most honest intentions they may supply the wrong tree, because, as has already been pointed out, it is not *Salix alba*, var. *caerulea*, merely that is wanted.

So far as our present knowledge takes us it is the erect-growing form alone that can be relied on, and then possibly the female plant only, and it is only safe to plant stock which has come originally from the counties of Essex, Suffolk, or Herts.

The usual method of propagating this willow is by means of "sets." These "sets" are branches cut as thick as or thicker than a broom-handle, with the minor branches and twigs removed; they are thus transformed into bare rods which when planted are 8 to 10 feet or even more in length. "Sets" o about this length are preferred so that the young growths may be out of reach of cattle, &c., and the young trees away from the various dangers that beset them when they are near the ground. They are also suitable for thrusting in hedgerows and such-like situations. Care should be taken to prevent cattle from injuring the stems. In some places willows are being pollarded for the especial purpose of producing "sets" of the desired size. But with the present demand for this willow this seems a slow and cumbersome means of propagation; slow, that is, to produce a large quantity; no doubt for the individual tree it may be the quickest. This willow is one of the most easily propagated of all trees, for every twig will grow. I would recommend the use of cuttings which can be made of any shoots as thick as a goose-quill and, say, one foot long. Cuttings of this character, planted in the Arboretum nursery at Kew last spring, are already (in August) six feet high. For thicker wood, the cuttings may be proportionately longer. These can be put in the ground in autumn or early spring. As they grow it would be necessary to keep them each to a single leader and to prune back the side branches and remove the lower ones as the plants grow in height. In well-kept nursery ground fine healthy plants could be produced in two or three seasons, and they could be grown to planting-out size at the rate of 8,000 or more to the acre.

Whilst these willows like abundant moisture, a position by the side of water is not necessary. The fine specimen here illustrated is, with several others, growing in a deep, rather heavy clay, with only an ordinary hedge-row ditch on one side. Mr. Shaw told me he preferred timber grown in such a position to that of trees growing close to the edge of ponds, &c.

Young trees should be watched to see that they are kept to a single leading shoot. This will obviate the forking of the trunk low down, which, of course, detracts from the value of the tree by reducing the amount of good timber. Trees, however, are more liable to fork when growing in isolated positions than they are when close together in plantations.

LONDON COUNTY COUNCIL EVENING SCHOOLS.

The London County Council desires to call attention to the facilities offered for evening instruction in the various institutions maintained by it or under its control.

In the various polytechnics, technical institutes, and schools of art situated in the county, classes in science, art and technology, music, artistic handicrafts, &c., will be re-opened towards the end of the present month. These institutions provide instruction of an advanced or technical character. Every facility is offered to different types of students to supplement workshop, office, or studio practice by evening study

under the most favourable conditions. Courses are arranged, where necessary, to prepare professional students for various examinations, art students for the examination of the Board of Education, and artisans for the examinations of the City and Guilds of London Institute, &c. The Council offers annually scholarships and exhibitions to the total value of £1,500 for competion among students of polytechnics, technical institutes, and art schools. The great success which has in the past attended the classes held at the Council's institutes and schools of art has made it necessary in several cases to provide for additional meetings of such classes to accommodate the increased number of students, and it is also proposed, provided the necessary number of students be forthcoming, to open certain new classes for which frequent application has been made.

The fees vary from 4s. 6d. to 10s. a session. In many subjects, apprentices, learners, and improvers are admitted free.

In 36 London County Council schools, centres for instruction in commercial and science and art subjects will be opened. These centres are in a degree contributory to the polytechnics and technical institutes mentioned above, and are primarily intended for students not sufficiently advanced for the polytechnic classes. Advanced work, however, is taken in many of the subjects. The instruction given in these centres includes commercial subjects, such as accountancy, banking and currency, commercial law, book-keeping, commercial correspondence, shorthand, typewriting and modern languages; science subjects, such as physiology, geology, mathematics, chemistry, hygiene, building and machine contruction; and art subjects, such as drawing in light and shade, model, freehand and geometrical drawing, memory drawing of plant form and common objects. The fees vary from 1s. 6d. to 5s. the session for one or more subjects, according to the age of the student and the character of the subjects taken.

In 237 London County Council school buildings situated in every part of London, ordinary evening schools will be opened this session. The instruction will, as a rule, be of a character preparatory to that given in the Centres, and will embrace commercial subjects such as book-keeping, shorthand, and modern languages, and general subjects such as arithmetic, geography, history and composition. Women and girls will be able to receive lessons in practical cookery, dressmaking, millinery, needlework and laundry-work; and instruction in woodwork will be provided for men and boys. Gymnastics will be taught, and lectures by doctors and nurses on first aid, home nursing, health and infant care will be given.

There are eleven special schools which provide suitable instruction for the deaf.

In 58 schools, situated in poor districts, no fees will be charged to any students, but as a rule a charge of one shilling for the session for one or more subjects will be made in the remainder of the schools.

A special effort is being made by the Council to encourage the study of English literature. Special lecturers have been engaged to deliver courses on the literature of various periods in 24 commercial centres and six secondary schools, &c. In the latter the lectures will be of a more advanced type.

The polytechnics and technical institutes will be open, as a rule, during the week commencing 23rd September, 1907. All the centres and the ordinary evening schools will be open for the enrolment of students in the week commencing Monday, 16th September, 1907.

Any persons who desire further information concerning these institutions should apply to the schoolkeeper of any of the Council's schools for a handbill giving particulars of the various institutions in the district. Full details are given in the prospectus of each institution, a copy of which may be obtained free on application at the institution.

THE PRODUCTION OF COCOA IN ECUADOR.

The principal product of Ecuador is cocoa, of which it furnishes nearly one-fifth of the world's production, now estimated at 300,000,000 pounds. The cacao tree grows on the warm lowlands and in the valleys tributary to the coast. The valleys adjacent to Guayaquil produce the greatest quantity of any district in the world. In 1900 there were 4,827 cacao plantations or farms in Ecuador, with a total of 58 million trees. The yearly production in pounds was as follows:—In 1900, 41 millions; in 1901, 53 millions; 1902, 54 millions; 1903, 49 millions; 1904, 61 millions; 1905, 47 millions; and in 1906, 53 millions. Guayaquil cocoa has a speciality of its own, both in appearance and aroma, and is easily distinguishable from the cocoa of other districts. The lower grades are very strong and coarse in flavour, while the better grades contain a larger percentage of theobroma, making them more valuable. This cocoa is divided into two classes, viz., up-river (*arriba*) and down-river (*abajo*); to the latter class belong the grades known as Machala, Balao, Naranjal, and Tenguel. The cocoa coming from the plantations situated in the up-river district is far superior and always sells at a higher price. The total annual exports of Ecuador, amount in value to £1,600,000, two-thirds of which is cacao, an article for which a world-wide demand exists, and in the production of which Ecuador enjoys a high reputation. The planting and cultivating of the cacao-tree is being carried on more extensively every year, and it is the general opinion that the article has a splendid future, and that the present production is not sufficient to meet the growing demand or consumption. The plantations are mostly in the hands of the natives, many of whom have amassed sufficient fortunes to make Paris their future home, according to the American Consul at Guayaquil. On some of the large plantations very fine residences are

found, although the owners, as a rule, seldom occupy them, preferring to live in the city. Some are also equipped with narrow-gauge railways. The United States is the largest buyer of cocoa from Ecuador, having bought in 1903 nearly nine million pounds, valued at £242,000; and in 1906, over ten million pounds, worth £292,000. In Europe, Germany gets the largest share. By statistics, France would appear to be the largest buyer, as a very large amount is sent to Havre for re-shipment, and the Ecuadorian Customs authorities enter this as consigned for consumption in France, whereas a great part of it is really not used in that country. It is estimated that the average yield of a cacao-tree is about one pound of cocoa per year, giving a planter, having a plantation of 50,000 trees, approximately 50,000 pounds of cocoa annually. When the cocoa-tree is in blossom, and the pods are commencing to grow, the appearance is beautiful. The flowers, which grow in tufts or clusters, are very small, having five yellow petals on a rose-coloured calyx. The seeds contained in each pod vary in number from twenty to forty, and are embedded in a soft, pinky-white acid pulp. The fruit is five-celled, without valves, from seven to ten inches in length, and three to four inches in breadth, of an elliptic oval-pointed shape. The rind of the fruit is very thick, and similar to a very hard, tough apple in substance, and has a slightly sweet taste.

TRAVELLING FARM SCHOOLS IN SPAIN.

The general progressive movement in Spain—a movement which is slow but sure—is expressed by a recent Government order creating a sort of travelling school for teaching scientific farming in the remote agricultural districts of the country—a measure which may have a certain commercial significance, since it will probably develop a demand for better agricultural implements and machines than those now in use. The Government order referred to provides for a course of experimental and practical instruction to be given every year by itinerant lecturers, selected from among the agricultural engineers at the district schools of agriculture. In the months of January and February of each year, the directors of these schools are required to report to the Department of Agriculture at Madrid, giving the programme of the lectures intended to be given during the ensuing twelve months, with an estimate of the cost, including travelling expenses and remuneration of the teachers, and transport of the agricultural machinery and appliances which it may be considered advisable to carry to those remote villages where the practical instruction is to be given. So far only the Schools of Agriculture at Zaragoza, Jaen, Palencia, Badajoz, and Barcelona, and the two stations at Haro and Villafranca del Panadés are referred to in this order; but if the movement proves a success it will no doubt be extended, and must lead to a wider use of modern farming appliances in Spain.

HOME INDUSTRIES.

Tin Supplies.—Although the price of tin has fallen heavily since May last, when it touched the highest price upon record, namely, £215 per ton, it is still—at £166 or thereabouts—higher than in any year since 1888, when at one time it touched £170, although during the same year it was quoted as low as £75. In 1896 it fell to £56 per ton, and the average of the year was £61. Tin is liable to these great fluctuations owing to the small production of the metal—last year the output was under 100,000 tons as contrasted with 711,700 tons of copper—and the consequent greater ease with which market movements can be manipulated. Probably there will be some further fall in the present quotation, but the decline is not likely to be great. There is a continuous though not very rapid growth of consumption, and the increase in supplies hardly keeps pace with it. On the one hand, little substitution of other metals can be effected. Glass is being substituted in increasing quantities for tin for enclosing perishable provisions, especially those containing liquid, but in other directions the demand for tin continues, and it is largely used in conjunction with other metals in the production of bronze, brass, Britannic metal, pewter, printers' type, thin sheet lead, white metal for silver plating, &c.; and solder is largely composed of tin. On the other hand, there is not much likelihood of great expansion in the output of the main producing countries. Excluding Bolivia and Cornwall, which are not included in the trade statistics compiled for trade information, the supply of tin has more than doubled during the last thirty years. In 1878 the output was about 35,000 tons, in 1906 it had increased to 75,000 tons. The Bolivian production is mostly sent abroad in the form of ore, averaging approximately 60 per cent. of metal contents, and the tin received from Bolivia has increased from 4,000 tons in 1896 to 14,700 in 1906. Although the high price of tin has encouraged the revival of Cornish mining enterprise, the output of 1906-7 was only a trifle over that of 1905—4,500 tons as against 4,468 tons. A mine that has been allowed to become flooded, as was the case with many of the Cornish mines, and where old plant has to be replaced with new, cannot get to work again immediately, but given a continuation of good prices, the Cornish output should increase considerably during the next year or two. As late as 1894 it amounted to 8,300 tons. Next to Bolivia, Australia furnishes the largest increase in output. In 1898 the shipments from that country were only 2,390 tons, last year they had increased to 6,452 tons, and information as to the industry warrants the expectation of further increase. The Straits Settlements continue to supply the bulk of the output, which, however, shows very little expansion. In 1896 the output was about 50,000 tons, in 1904 it had increased to 60,680 tons, but last year it was no more than 58,443 tons, or, roughly, three-fourths of the whole world's supply. Stocks of tin have been

heavily drawn upon, the stock and visible supply falling from 32,189 tons in 1896, to 13,118 at the close of 1906.

The Manufacture of Stilton Cheese.—Surprise is often expressed at the small quantity of Stilton turned out in this country. The manufacture is almost entirely restricted to one part of England, the centre of which is Melton Mowbray, and farmers make and buyers buy only for a part of the year round about the Christmas season. What is the explanation? Why is it that it is difficult to get Stilton, and that there is no export trade in this the finest of cheese? An acknowledged authority on the subject, Mr. James Long, deals with this question in an interesting article he has contributed to the *Manchester Guardian*, of September 3rd. Mr. Long points out that the Gorgonzola of Italy, which is of a similar character, although much inferior, is placed upon hotel and other tables throughout the whole of the year, whilst the French not only produce blue-veined cheese during most of the year—although the climate in the departments in which the cheeses are made differs little from our own—but the people eat them, and consider no important meal complete unless something of the kind is placed upon the table. The explanation seems to be that the process of production in this country is very defective. A large proportion of the Stilton made is of second or third quality. The rennet used is imperfect, and the quantity supplied too small or too large. The curd is dried too much or fails in mellowness, or, worst of all, the milk is tainted and the utensils impure. The last is perhaps the greatest failing of all, for if sweet milk comes into contact with sour milk by the use of a foul utensil it is inoculated with germs which increase with great rapidity and spoil the whole. A farmer whose dairy contains a large proportion of spoiled Stiltons usually fails to obain more than 6d. per lb. and loses money, whereas a maker of the best obtains a shilling and finds the industry a profitable one. Mr. Long gives some interesting particulars. The price paid by the Stilton maker to the farmer for good milk varies from 4½d. to 5d. a gallon. More than a gallon is required to make a pound of cheese. At the British Dairy Institute on the average of five years 12½ lb. of milk was used in May, 11½ lb in June and July, 10½ lb. in August, and 10 lb. in September, a gallon weighing slightly more then 10 lbs. Thus in May the milk at 4½d. required to make a lb. of Stilton cost over 5½d. Hence with labour, plant, rennet, wear and tear, and interest on capital laid out, there is an actual loss where 6½d. only is obtained for the cheese. The possible loss in making cheese on a large scale is considerable. When milk is bought it is paid for long before the cheese returns a penny. For example, if twenty cheeses are made daily, with 15 gallons for each cheese, the maker may have to pay a weekly cheque of nearly £40, or still more, in the early months. These facts explain why the manufacture is so small. There is want of knowledge and mastery of the work necessary to do away with the fear of loss. Many makers are only just able to jog along, since they have never taken the trouble to inquire where they are wrong. Often the work is left to a member of the family, ill equipped for it. Then there is want of enterprise as between makers and dealers. People who pay for bad Gorgonzola would sooner pay for good Stilton if only they could get it.

The Cotton Outlook.—It is, perhaps, unlikely that the coming cotton season will be as good both as to demand and profits as that of the last two years, but the prospect at this moment is not discouraging. Presuming upon reasonable prices for cotton, the volume of trade is likely to be large, and probabilities point to a reasonably low price, which would be better both for the mills and the weaving sheds than any other. There is a large carry-over, not only in the visible supply, but also in the hands of spinners. Mr. Thomas W. Elliston, on August 12th, estimated Continental spinners stocks at 1,432,000 bales of all kinds of cotton, or fourteen weeks reserve supply. The estimated English reserve is 516,000, or about seven weeks supply. The carry-over in Europe will be by far the largest for years past, and should have a sobering influence upon the course of prices. As to the probable size of the crop it seems certain that the acreage in America is unusually large. The Bureau says 30,060,000 acres, or 2,000,000 more than in the big crop year of 1905. The *Financial Chronicle* says 33,079,000 acres, and other authorities put it at a still higher figure. The crop met with a cold and wet spring, and much land had to be replanted, some more than once. But the weather reports since the beginning of June have not been unfavourable. Generally the plant is said to be small but heavily planted. Given favourable weather in the ensuing weeks the crop bids fair to be a good average with less low cotton and more good middling relatively to the size of the crop than in the past season. The proportion of high grade promises to be at least an average. The prospects of the Egyptian crop, too, are very favourable. The Alexandrian Produce Association has published a statement of the acreage of this year's crop, which shows a wonderful increase, no less than 67,000 feddans in Upper Egypt, and 29,000 in the Delta. The promise of a record crop has checked buying at Alexandria, and purchases are not stimulated even by the concessions of cultivators, who are said to be offering their lint at prices in considerable disparity with printed quotations. It looks, therefore, as if there will be no lack of raw material this year. As to how profitable the business will be to the spinner and manufacturer, much will depend upon how far the demand can absorb the products of the large increase of machinery now at work and getting to work at home and abroad.

Shellac.—Three or four years ago, the price of shellac, which is used in large quantities by hat

manufacturers at Denton, Stockport, Hyde, and other places round Manchester, was about one-third of what it is to-day. The reason for the rise is doubtful. It has been attributed to the growing demand of the electrical trade, and to the increasing use of high-grade varnishes; but these explanations seem inadequate, for if it be true that the demand increases rapidly every year, it is equally true that the supply seems to increase *pro rata*. There is reason to believe that the standard of purity in the supplies is lower than formerly. India is shipping large quantities of shellac, but it is complained that this season almost every quality has been largely adulterated with resin and other gums. The two principal varieties of shellac are "button" and "orange" lac. Button lac is made in flat cakes, more or less circular in form. Orange lac is also used extensively in the manufacture of varnish. It is usually met with in thin, shivery flakes, and is much easier to judge as to quality than the other.

A New Butter Process.—A new process for the better preservation of butter is on view. Bacterial examination of the action of carbonic acid on cream suggests that it prevents the development of noxious bacteria. Cream and butter turn bad from the action of oxygen in the air, and bacteria contained in the air. In their ordinary treatment, the water in them contains oxygen which is mixed all over the butter and assists in the oxidation of the fatty matter. In the new process the oxygen is displaced by the carbonic acid, and it is claimed that no oxygen remains in the butter, and also that the water contained in it is carbonated and so keeps the butter free from oxidation or bacteria which cannot live without oxygen, and are detrimental to its quality. Chemical preservatives detrimental to health are said to be absent from the process, and it is claimed for it that it is a very simple, cheap, and effective treatment. The process is at least interesting and novel. Theoretically it appears correct, and unless in practice there turn out to be objections to it, or difficulties in working the process, it should prove of value to those connected with the dairy industries. The matter is hardly yet beyond the experimental stage, but there is a probability of the process being tried on a commercial scale by some manufacturers of butter.

GENERAL NOTES.

JAPAN.—In his report on the trade of Japan (Cd. 3283), Mr. Harrington, Acting Commercial Attaché to His Majesty's Embassy at Tokio, refers to the spirit of speculation that swept over Japan in 1906 and early in the present year, illustrating it by the subscriptions for the shares of the South Manchurian Railway Company. One hundred thousand shares, totalling 20,000,000 yen (£2,040,000) were offered for subscription. Arrangements were made by which the receiving banks retained the deposits on application, paying interest therefor, while at the same time the banks were able to lend money for application at a higher rate of interest. Thus were persons with inadequate means able to apply for shares, and, in anticipation of over-subscription, excessive quantities of shares were applied for. The result was that some 12,000 persons made application for no less than 106,730,000 shares. This number would represent some 21,346,000,000 yen, or not far short of the largest estimate hitherto made of the total capitalised wealth of Japan. Towards the end of the year an extraordinary appreciation took place in the shares of most companies, due in many cases to speculation on futurity shares, *i.e.*, on shares which were expected to be issued as the result of increases of capital, and which were considered certain to be above par like the original shares. Eventually, in January and succeeding months, everything was forced down, causing great depression in the money market and business generally. Several computations, says Mr. Harrington, of the total wealth of Japan have been made. The most recent, and possibly the most satisfactory, estimate places the capitalised wealth at approximately £2,311,000,000, excluding Formosa.

SWEDISH FISHERIES.—The Swedish Government is doing a good deal to develop the sea fisheries of Sweden as well as the river and inland fisheries. The nation appears to be realising the great importance of the proper care and administration of the fisheries as well as of the industries connected therewith. In order to assist the seaport population and fishing enterprises the Government has placed a comparatively large sum at the disposal of the local authorities upon very easy terms, and the fishermen have largely availed themselves of this opportunity for the purpose of improving their craft and gear. Mercantile associations also have benefited by support from the Government in this direction. Thus a herring fishing expedition to the Islands has obtained a grant of money from the State which has enabled those interested to provide a complete and proper outfit. In his report on the trade and commerce of Gothenburg (3283-167) Mr. Consul John Duff says that the purse-seine which was introduced into Sweden some 20 years ago, and at first received by the fishing population with distrust, has gradually made its way, and with the modern motor-boat as auxiliary, the outfit of to-day's herring fisher may be looked upon as perfected. The rational lines upon which the fisheries are now worked give those occupied in the industry a return far beyond that of the fisheries of former times, even in the bright days of the great herring fishing. The ancient stock of "poor fishermen" who with their line, net, and small gear, gleaned a precarious living out of the sea, will soon be a memory of the past.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

"OWEN JONES" PRIZES FOR INDUSTRIAL DESIGN.

This competition was instituted, in 1878, by the Council of the Society of Arts, as trustees of the sum of £400, presented to them by the Committee of the Owen Jones Memorial, being the balance of subscriptions to that fund, upon condition of their expending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers and Hangings, Damask, Chintzes, &c., regulated by the principles laid down by Owen Jones." The prizes are awarded on the results of the annual competition of the Board of Education, South Kensington.

Six prizes were offered for competition in the present year, each prize consisting of a bound copy of "The Leading Principles in Composition of Ornament of Every Period," from the Grammar of Ornament, by Owen Jones, and a Bronze Medal.

The following is a list of the successful candidates :—

Bloom, Dorothy, School of Art and Design, Nottingham.—Design for a Stencilled Hanging.

Crompton, Oswald, School of Art, Sunderland.—Design for Tapestry.

Newman, Samuel, School of Art, Macclesfield.—Design for a Woven Silk Hanging.

Powell, Ellen, School of Art, Stroud.—Design for Printed Muslin Hangings.

Sumner, Philip, School of Art, Macclesfield.—Design for a Tapestry Hanging.

Willock, John. S., School of Art, Manchester.—Design for a Stencilled Hanging.

The next award will be made in 1908, when six prizes will be offered for competition.

SECTIONAL COMMITTEES.

APPLIED ART SECTION COMMITTEE.

The following is the list of the Applied Art Section Committee, as appointed by the Council :—

Sir Steuart Colvin Bayley, K.C.S.I., C.I.E. (Chairman of the Council).
Sir George Birdwood, K.C.I.E., C.S.I., LL.D., M.D. (Chairman of the Committee).
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Arthur Crozier Claudet.
Alan S. Cole, C.B.
Sidney Colvin, M.A.
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Henry Hardinge Cunynghame, C.B.
Cyril Davenport, F.S.A.
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William Edward Riley, F.R.I.B.A.
Alexander Siemens.
A. B. Skinner, B.A., F.S.A.
R. Phené Spiers, F.R.I.B.A., F.S.A.
Hugh Stannus, F.R.I.B.A.
H. H. Statham, F.R.I.B.A.
Carmichael Thomas.
Professor John Millar Thomson, LL.D., F.R.S.
Sir Thomas Wardle.
Sir Aston Webb, R.A., F.R.I.B.A., F.S.A.
Henry B. Wheatley, F.S.A. (Secretary).

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

GOLD MINING AND GOLD PRODUCTION.

By Prof. John Walter Gregory, D.Sc., F.R.S., F.G.S.

Lecture II.—Delivered February 4, 1907.

II.—Gold-bearing Lodes.

The ideal of mining being the extraction of ores and minerals at the minimum of cost, mining operations should be guided by the best available evidence as to the underground courses of the ore deposits, in order to avoid the waste of search in wrong directions; and the miner should use the best available clues as to the depth to which a lode is likely to extend and as to its variations in value with depth, so that the mining equipment selected may be economically suitable to the work it will have to do. Hence comes the practical value of theoretical questions as to the geological characters and genesis of ores.

Alluvial gold is detrital in origin: at one time the belief was popular that the gold grains and nuggets in gravels grew there from percolating solutions. This view has a strange fascination over practical alluvial miners; and it is still occasionally advocated in mining literature.

Alluvial gold is derived from the destruction of gold-bearing lodes, and when the alluvial deposits of a field are exhausted the miner turns his attention to the lodes from which the detrital gold was derived. The work changes from alluvial to lode mining; and the gold in lodes is so constantly associated with quartz, that all gold lode-mining is sometimes spoken of as quartz-mining. Gold is, however, found, though usually only as a subsidiary constituent, in ores of silver, copper, lead and zinc.

The Term "Reef" and its Opposite Meanings.

The quartz sheets in which gold occurs are called lodes, reefs, or veins. In accordance with the practice of Australia and South Africa, the generally adopted British term is reef; but that word must be used with caution, for it is used in different mining fields with exactly opposite meanings. On one field, the "reef" is the gold-bearing ore; on an adjacent field the reef, on the contrary, is the barren rock in which the ore deposits are included.

The responsibility for this confusion rests with Australia. During the first half of the last century, sheets of metalliferous ores were known as veins or lodes. Thus the Cornish mines derived their ores from the Standard Lode, Daniell's Lode, &c. From Cornwall, the term lode was introduced into America, and thus the great gold-quartz veins of the Sierra Nevada received their name of the "Mother Lode" of California, and the most famous ore deposit of Nevada is known as the Comstock Lode, not the Comstock Reef. The term reef was introduced into mining in Australia. The miners there began work on the alluvial deposits, and excavated them down to the underlying bed rock; then, in accordance with a habit of using nautical terms acquired in the long voyage to Australia, the miners said they had struck a reef; for striking the bed rock was as fatal to their mine as striking a submerged reef at sea would have been to their emigrant ship. So the bed rock was called the reef, a perfectly correct use of the term. When mining proceeded to the gold-quartz veins, they were described as reef-quartz, to distinguish them from the quartz pebbles of the alluvial deposits. From speaking of the quartz as "in the reef," the passage was easy to calling the veins "quartz-reefs," and thus the term reef passed from meaning barren material into a synonym for a lode. The term is still used in its original meaning in alluvial mining. Thus, the "reef drive" of a deep lead mine is the drive in the underlying, barren bed rock. It is probably too late to get rid of the double use of the word reef, and it is, therefore, important to remember that the term is ambiguous owing to its local reversal of meaning. The older name, lode, is not open to this objection.

Classification of Gold-bearing Lodes.

Gold is found in lodes of many different types. The most typical gold-bearing lodes consist of sheets or masses of quartz, traversing barren rocks, which are technically named the "country." The lodes often occur in slates, which are readily worn away, so that the harder, more resistant quartz may stand above the surface in long, narrow walls.

Quartz mining in Australia was begun by a party of French miners chipping out the pieces of quartz showing visible gold from such an outcrop at Black Hill, Ballarat, and then crushing the fragments with hammers. After the outstanding part of a lode has been removed, the lode is followed down and quarried

by an open-cut. The rest of the lode, which is too deep for open working, has to be reached by a shaft and underground mining.

A lode may have parallel, well-defined sides, and such lodes are often of great length and depth. But, unfortunately for the quartz miner, even a thick lode may break up into thin quartz veins running irregularly through the country rock; or it may taper out and cease altogether. Vein quartz also occurs in lenticular masses, known as "makes," "bulges," or "blows"; so that what appears to be a thick quartz sheet may be only a part of a lens-shaped block, which, when followed downwards, soon becomes thinner and disappears. A thick quartz mass may be reduced to a mere string of quartz; it too may disappear, leaving only a narrow empty "lode track" which may, however, lead to another mass of quartz.

A lode may be formed by the filling of a fissure caused by the shrinkage of the rocks, or by a fault. The fissure may open above to the surface, and may be continuous across several rocks; or it may be a crack confined to one bed of rock, in which case it is called a gash vein. The quartz may occupy the whole width of the lode; or it may be deposited in the spaces between broken fragments of the adjacent rocks which have fallen into the fissure, or been torn off the walls. Some quartz lodes have sharply defined margins, but in others there is a gradual passage from the lode to the older rocks beside it; and these lodes are sometimes so thick, and occur at depths where the pressure is so great, that large fissures could not have remained open; moreover, projecting tongues or loose blocks of slate occur floating in the quartz in positions they could never have retained in an open space. Such lodes cannot, therefore, have been formed in fissures; many geologists were accordingly persuaded that quartz veins are of igneous origin; the quartz was thought to have been forced up from below in a molten state, to have pushed the rocks apart, and at the same time been injected into any adjacent cracks. Quartz veins were thus regarded as intrusive quartz dykes. This theory is, doubtless, true for a few quartz veins. There are igneous quartz dykes which are due to all the basic constituents in a molten rock having crystallized out, leaving the acid material to flow on as molten silica. They are the ultra-acid residues from ordinary quartz-felspar dykes. But I have seen no case in which quartz of igneous origin is payably auriferous. The economically important gold-quartz lodes have had quite a different origin from such quartz dykes. The thick lodes are due to the slow replacement of slate or sandstone, particle by particle, by quartz. This process forms thick sheets of quartz, without the necessity for the existence of open spaces. Such lodes are described as metasomatic or replacement lodes, and more and more of the chief quartz lodes are being recognised as of this origin.

Quartz veins vary not only in mode of origin but in form, and in their relations to the surrounding rocks. The veins may run down as pipes in "pipe veins," as continuous sheets in "fissure veins," as a network of quartz enclosing broken masses of mullock along faults, or as irregular ramifications through a belt of shattered country between two powerful faults, or in numerous veinlets in the fractures beside faults, or as successive horizontal platforms or steps, or as "bedded veins" parallel to the bedding in the surrounding rocks.

The most useful classification of gold lodes rests on the nature of the rock in which they occur. The chief groups of lodes, arranged according to their character, are as follows:—

(1). Gold-quartz lodes in sedimentary rocks.

(2). Gold-quartz lodes in foliated igneous rocks.

(3). Mineralised belts of rock traversed by quartz-veins and veinlets.

(4.) Quartz lodes in association with propylitic igneous rocks, especially diorites.

(5). Gold-quartz lodes in non-schistose volcanic rocks.

(6). Gold occurring as a by-product in masses of pyrites or other sulphides, with their overlying rich secondary gossans.

(7). Gold-quartz ores formed by infiltration of gold into sediments, especially limestones and dolomites.

(8). "Banket," *i.e.*, ancient auriferous conglomerates, according to some authorities, should also be included among lodes.

(1).—Gold-quartz Lodes in Sedimentary Rocks.

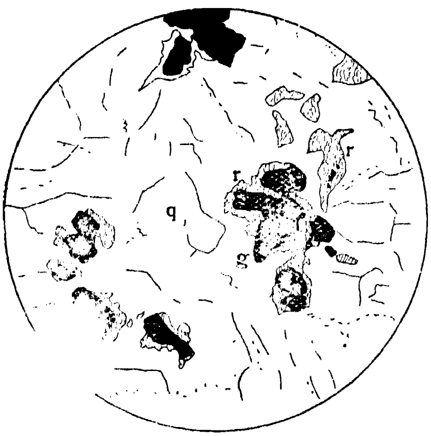
Of these various classes of gold ores, the most typical are the gold-quartz lodes and veins found in sedimentary rocks. They are, as a rule, found in slates, but they also occur in quartzites and limestones. The quartz is of the variety known as vein-quartz, which has been deposited from water. The lodes may consist of a sheet or pipe of quartz, of an irregular net-work of quartz-veins, of isolated lens-shaped masses, or of series of quartz

veins ramifying through a belt of mineralised country.

The simplest type of these gold-quartz lodes are simple fissure veins Fissure veins often divide into many branches which are connected by cross veins, and thus form a complex lode. Many important lodes are found along faults, and contain broken fragments of the country rock; they are often called "brecciated lodes," from the abundance of angular masses of mullock included in them.

Where the country beside the lode is much fractured, the vein-quartz may not be limited by sharply defined boundaries, and there is a

Fig. 8.



A Thin Section of Gold-Quartz Ore with Free Gold. Sumpter, Oregon (after Lindgren) × 28 dia, q = quartz, g = gold, r = roscoelite.

gradual passage from the quartz into slate beside it. The slate has been silicified, its original constituents having been removed and replaced by silica, till at length part of the rock is converted into ordinary vein-quartz. It is often impossible to draw a line between a simple fissure-vein formed along a fault or a joint and a replacement lode; and some lodes were first formed as fissure-veins, and have been enlarged by the replacement of the rock on the walls.

Lodes along faults have a tendency to develop into alternate masses or lenticles of quartz connected by a thin lode-track. The masses fill the spaces formed where the two walls of the fault are forced apart owing to the meeting of projecting surfaces.

Bedded veins, on the other hand, are often remarkably regular, as they follow the bedding planes. Where the rocks have been folded into alternate arches and troughs, the quartz may be deposited in thick bands along the tops of the arches and in the bottoms of the troughs, as the pressure in those positions was less than on the sides of the folds. Thus have been formed saddle lodes and inverted saddle lodes.

The most famous representative of all the lodes in sedimentary rocks is the great "Mother Lode of California." It is not one continuous vein, but a belt of many parallel and branching veins, which increase and decrease in thickness, and disappear and reappear on the same line. This complex lode can be traced for 112 miles north and south along the Sierra Nevada. It occurs in slates and sandstones of Carboniferous and Mesozoic age, which have been penetrated by great masses of igneous rock, known as granodiorite. The fracturing of the earth's crust and heating of the area during the invasion of these igneous rocks rendered possible the ascent of the gold-bearing solutions.

The gold-quartz lodes of Victoria include many examples of this group, most of them are in Ordovician slates, and many of them were formed before the Carboniferous period, so that they are much older than the lodes of California. The slates in Victoria have also been invaded by granodiorites and allied igneous rocks. Many of the chief gold lodes occur in the neighbourhood of these intrusive masses.

The great gold-quartz lodes of Ballarat West are typical examples of continuous sheet-like lodes, and the mines have followed shoots of gold ore down to the depth of 2,300 feet. The adjacent mines of Ballarat East, on the other hand, work lodes formed as an irregular network of quartz-veins ramifying irregularly through slates and sandstones. Saddle lodes are best developed in the Bendigo Goldfield in Victoria, and near Halifax in Nova Scotia.

(2.)—Gold-quartz Lodes in Foliated Igneous Rocks.

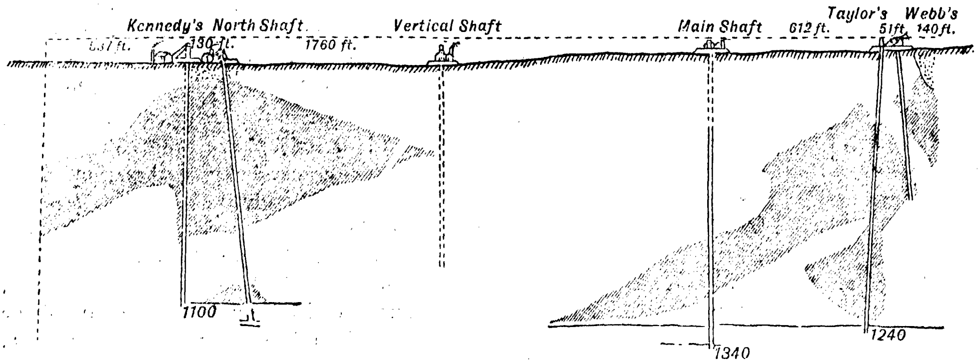
Gold-quartz lodes in igneous rocks which have been altered into schists are usually less regular than those in sedimentary rocks. The lodes are very variable in thickness, while their walls are often extremely irregular and indefinite. This is a natural consequence of the fact that igneous rocks, owing to their more complex chemical composition and higher proportion of soluble constituents, are less stable than sedimentary rocks, which are composed of simpler and less changeable materials. Hence most of the lodes found in

schistose igneous rocks are in the main replacement lodes.

Schistose igneous rocks, however, often preserve a more uniform composition in depth than sedimentary rocks, and it is, therefore, not surprising that the lodes and ore shoots in them often continue to great depths.

nated with auriferous sulphides are of great importance from their vast size, although the ores are usually of low grade. The lodes often occur in granite, using that name in its popular sense. Sometimes the quartz veins are so thin and pass so imperceptibly into the quartz grains of the country rock, that they are easily overlooked, and thus the gold has been described as a primary constituent of the granite.

FIG. 9.



LONGITUDINAL SECTION THROUGH THE NUNDYDROOG GOLD MINE, showing the dip and form of the Ore-Shoots. (After Hatch.)

Goldfields on schistose igneous rocks may be illustrated by Kalgoorlie with its famous Golden Mile. The lodes have been formed by replacement. They are generally in altered amphibolites, but sometimes the mineralisation passes outward into the granitic rocks beside the schists. The Kalgoorlie ores are very complex and refractory, and the absence of water placed great difficulties in the development of this field. But water is now pumped to it from the coast, through a pipe 350 miles long, and the ingenuity of the Australian miners has overcome the metallurgical obstacles to the extraction of their gold. The lodes have been followed down to the depth of over 2,000 feet, where the ores, though poorer than near the surface, still maintain rich values.

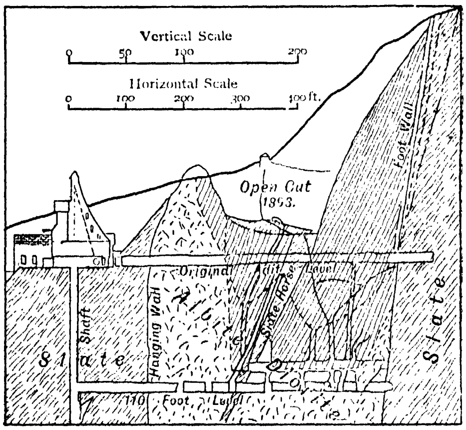
A simpler type of lodes belonging to this group is developed in Mysore in India, for the hornblende schists of the Kolar Goldfield, according to Holland's description, are altered igneous rocks. The shoots have been followed with well maintained values, down to the depth of 3,000 feet. The gold mines in the Selukwe and Sebakwe districs of Rhodesia occur in a field of which the structure in many respects resembles that of Mysore.

(3).—MINERALISED GOLD-BEARING BELTS.

Lodes which consist of mineralised belts of rock seamed with gold-quartz veins or impreg-

The simplest of these lodes are dykes of a variety of granite known as beresite, found at

FIG. 10.



SECTION ACROSS THE ALASKA TREADWELL MINE. (After Becker.)

Beresov in the Urals. Representatives of this group of greater economic importance are worked in many parts of the world in granitic rocks, such as the Alaska Treadwell Mine, on Douglas Island, off the coast of Alaska. Its ore is a mineralised "granite" or albite-

diorite; it is of low grade, containing gold to the value of 10s. 10d. to the ton, but the quantity is enormous; the mine is worked for a length of 3,500 feet, and the ore is crushed by a mill of 540 stamps. Owing to the large scale of the operations, and the use of water-power, the ore is treated for a total cost of 5s. 4d. per ton. The Jumbo Mine in Rhodesia represents another of these low-grade broad bands of "granite" impregnated with gold-bearing sulphides.

A second series of mines in mineralised belts of rock includes those in quartz-schists and quartzites. The most famous of them is the Homestake Mine in South Dakota, at present the greatest gold mine in the world. The country rock is a wide band of quartzite, seamed in all directions with gold-quartz veins. The lode has been mined for a width of 550 feet; the ore is crushed in three mills having a total of 1,000 stamps, and its gold is recovered by simple cyanidation. The Wanderer Mine in Rhodesia is another low grade mine with similar geological characters. It is a mineralised band of iron-bearing schistose quartzite.

The future of the gold mines of this group depends upon whether the gold will be confined within narrower limits in the deeper levels of the lodes. If the ore keeps of the same width and low grade as near the surface, the limit of profitable mining will be comparatively shallow, although the Homestake Mine has already a shaft down to the depth of 1,400 feet.

(4).—Lodes connected with Propylitic Diorites.

The next important group of gold-quartz lodes are those associated with various dykes of igneous rock, and especially with diorite. This name is, however, given to many rocks which would not be accepted as diorite by a particular petrographer; but most of them are allied in chemical composition to true diorite, though, owing to differences in the conditions of their consolidation, they may differ in their mineral composition and structure. Many of the so-called diorites are hornblende-porphyrites, while many of the massive representatives are called grano-diorites, being intermediate in composition between granite and diorite.

The lodes of this group are intimately and usually directly associated with the adjacent diorite. The lode and the diorite dyke may be in close contact, or, perhaps, occasionally separated by a block of the country rock. This type may be illustrated by the Long Tunnel and the Long Tunnel Extended Mines at Walhalla in Victoria. There the chief lode —the Cohen Lode—has been worked in more or less constant company with a diorite dyke to the depth of 3,100 feet.

In other mining fields the lodes are confined within the diorite; they then often consist of horizontal layers or floors of quartz, arranged like the rungs of a ladder. The dyke itself may be nearly vertical, while the quartz floors extend across it horizontally. Such "ladder lodes" are due to the igneous rock having cracked by contraction as it cooled; silica dissolved from the adjacent rocks was deposited as vein-quartz in the contraction spaces. Where the diorite happens to be firmly attached to the slates beside it, the fissures caused by the shrinking of the dyke extend into the slates; and in such cases, the quartz veins extend beyond the dyke, to which, as a rule, they are confined.

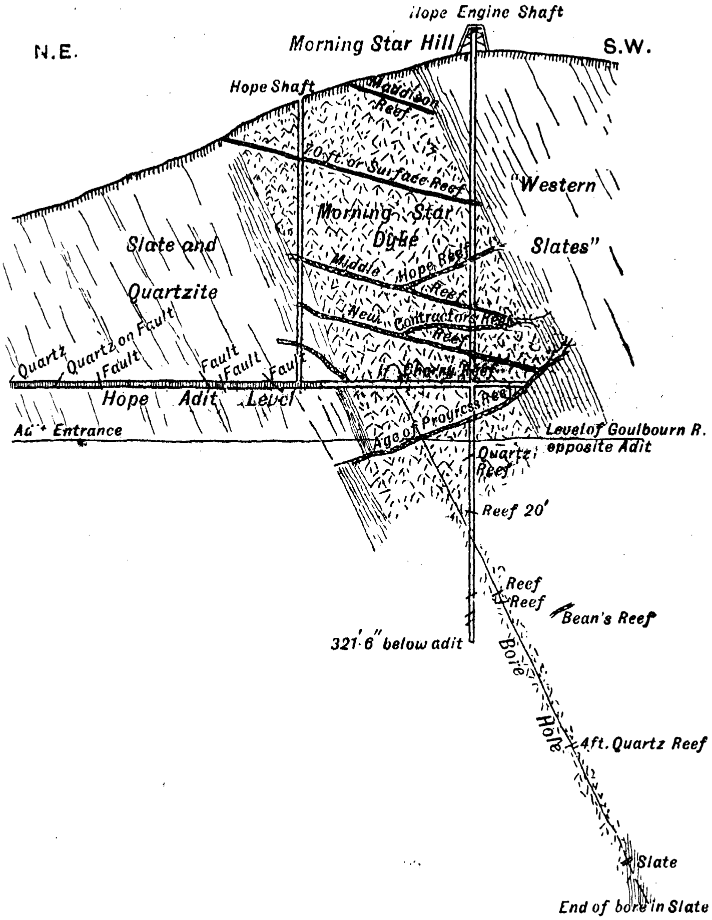
In most gold-fields where the lodes are in contact with diorite dykes, there has been lively controversy as to whether the dykes determine the amount of gold in the adjacent lodes. Very contradictory evidence has been adduced, which is, however, explained by the microscopic study of the rocks. Where the dyke is unaltered it appears to have had no effect upon the gold contents of the lode. But where the diorite has undergone the change known as propylitization, the adjacent rocks are auriferous. This change consists in the alteration of the original constituents of the diorite; the felspars have been changed into a secondary mosaic of quartz, felspar, and zoisite; the hornblende or other ferro-magnesian mineral has been converted into grains of epidote and chlorite. This propylitic action is a secondary process, which happened after the intrusion of the igneous rock, and usually affected both the diorite and the adjacent sediments. It is to this secondary action, and not to the diorite itself that the gold is due. The propylitic change can be certainly determined only under the microscope, but when its action has been thus detected, the change can usually be recognised in hand specimens of the rock. Among well-known mines in propylitic diorites are the gold mines of Chemnitz in Hungary, the famous Comstock Lode in Nevada, the Ayrshire diorite dyke in Rhodesia, and the A1 Mine at Gaffney's Creek, Victoria.

(5).—Gold Lodes in Normal Volcanic Rocks.

Gold ores in association with non-schistose volcanic rocks are of great importance in various parts of the world, and some of them have been formed in comparatively recent times. These volcanic rocks differ from the schistose igneous rocks as they are younger, and have not been crushed into schists; and they differ from "diorite" as they are essentially volcanic rocks, which have been discharged in lava flows over the earth's surface, instead of being subterranean intrusions. The gold mines of this group may be illustrated by three chief types.

Cripple Creek, in Colorado, at present the richest gold-producing locality in America, is perhaps the most interesting. It is the stump of an old volcano, and is situated in the Rocky Mountains, a few miles to the west of Pike's Peak. Its ores are arranged in shoots and chimneys rising through the old volcanic neck. That hot vapours due to volcanic action were present during the introduction of the ores is indicated by the abundance of fluorspar in the lodes. The ores are more complex than those of ordinary gold-quartz lodes, and, as some of the gold is present as telluride, the ores require complex metallurgical treatment. The San Juan Goldfield in south-western Colorado contains vertical lodes traversing a thick series of volcanic rocks and breccias. The ores contain abundant tellurides, as we are reminded by the fact that one of the mining towns in this field is named Telluride.

Fig. 11.



Section Across a Ladder-Lode. The Morning Star Dyke, Wood's Point, Victoria. (After a survey by O. A. L. Whitelaw, 1905.)

Waihi, the chief gold mine of New Zealand, is situated in a wide volcanic plateau, and is also assigned to this group, but it has some resemblances to the mines associated with the propylitic diorites.

(6).—GOLD IN SULPHIDE ORE MASSES.

Gold as a subsidiary constituent is present in many masses of pyrites and lead ores. In these cases the mines are worked for their copper and lead, the gold being recovered as a by-product. As a representative of this group may be cited the Mount Lyell Mine in Western Tasmania, which was first opened as a gold mine, but subsequently developed as a low-grade copper mine. To a variety of this group belongs one of the most interesting and most discussed gold mines in the world—the Mount Morgan Mine in Queensland. It consisted in its upper workings of a siliceous ore showing such clear evidence of deposition from solution that it was originally described as a geyser deposit. The gold in the uppermost part or gossan of the lode had been deposited from solution, and its separation from other metals had been so thorough, that Mount Morgan gold still holds the record amongst the mines of the world for the purity or "fineness" of its gold. Some of it contained as much as 997 parts of pure gold in 1,000 parts of native gold. It is now generally understood that the cap of this remarkable mine is only the altered silicious gossan of a great mass of pyritic ore, which is now being worked. The Mount Morgan Mine after being famous for the exceptional richness of its gold ores, has begun a fresh period of usefulness as a low grade copper mine.

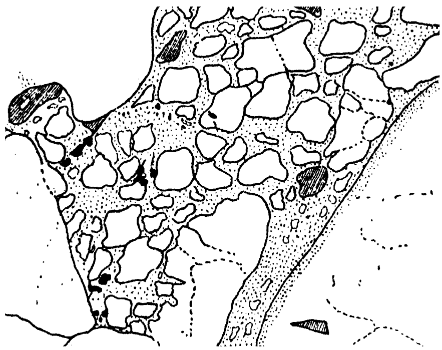
(7).—GOLD IMPREGNATIONS IN SEDIMENTARY ROCKS.

Gold ores due to the infiltration of gold into sedimentary rocks are formed mainly in quartzites, limestones, and dolomites. The solutions have usually risen up faults or beside dykes, and have then spread horizontally along a bed of permeable rock. One of the best established cases is that of the siliceous gold ores of South Dakota, near the Homestake Mine; the gold solutions have come up along the edges of dykes, and long vertical cracks known as "verticals." The ore bodies thus produced are compact and well defined.

(8).—AURIFEROUS BANKET.

Ores due to the infiltration of solutions into sedimentary rocks are comparatively unimportant, unless, as is asserted by a prevalent view, the gold of the Rand banket is of this origin. The ores of the Rand goldfield consist of beds of conglomerate or pebble reef, known as banket; this rock is charged with pyrites, and is often rich in very fine gold. (Fig. 12.) The banket or pebble-

FIG. 12.



BANKET. SECTION OF SPECIMEN OF THE MAIN REEF LEADER, containing 1,383 dwt. of gold per ton, × 25 dia. The section includes part o one large pebble of quartz and of two smaller pebbles; the rest consists of a fine quartz grit. The interspaces between the quartz grains are occupied by a dusty material composed mainly of minute flakes of sericite and kaolin, with small crystals of chloritoid. The large shaded areas are pyrites; the grains in solid black are gold.

reef was at first regarded as an old marine shingle beach, in which the gold was of alluvial origin. Evidence was soon forthcoming to show that this was not a full explanation; and it was suggested that the gold had been precipitated from solution in sea water, and then mechanically concentrated in the coarse conglomerates. This view is now only of historic interest. The theory which has been most generally accepted in recent years is that the gold has been introduced in solution and deposited in the conglomerate as in an ordinary gold-quartz lode.

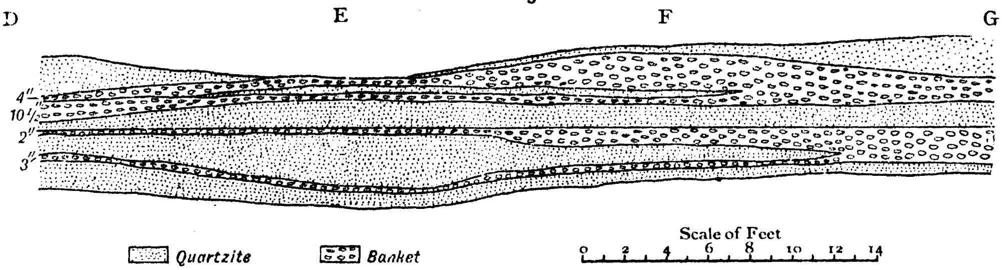
There is no time to go into this question, which I hope to treat shortly elsewhere; but the differences between the ores of the Rand and ore of which the gold has unquestionably been introduced in solution, and the many striking resemblances between the distribution of the gold with that of placer deposits, lead me to agree with the authorities who hold that the pebble-reef is an old placer, in which the gold was of alluvial origin, but has been dissolved and redeposited *in situ*.

THE MICROSCOPE IN MINING GEOLOGY.

The characters of the different types of gold ores may best be recognised under the microscope. The use of the microscope in mining geology is of the highest value, and to it we owe the great progress which has been made during the last few years in the explanation of the genesis of ores. The evidence thus obtained, as to the origin of the ores gives, moreover, most illuminating clues to their distribution. Chemical analysis often detects no difference between ores of fundamentally different natures. A siliceous bedded ore and the vein quartz of a vertical gold-quartz lode may have identically the same composition. The chemist could recognise nothing in a specimen from the former inconsistent with its having come from a lode, which might carry its ore shoots down to vast depths. The microscope, however, would at once show that, though such a rock may be entirely composed of silica, it may have been formed by the silicification of a bed of dolomite; and any prudent miner would be prepared to find that the ore was either limited to that bed or completely changed its character if the lode passed into another rock.

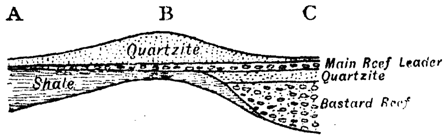
The microscope, moreover, can be of invaluable assistance to the mining engineer in detecting salting. Most of the commonest and most successful tricks of the salter can be detected by the study of the samples under the microscope.

FIG. 13.



SECTION ALONG 45 FEET OF THE SOUTH REEF IN THE NEW GOCH MINE, JOHANNESBURG, showing that the banket occurs irregularly interbedded with layers of quartzite. At D the section includes 4 beds of banket, in descending order, 4 inches, 10½ inches, 2 inches, and 3 inches thick, and of value respectively of 25 dwt., 5 dwt., 2 dwt., and 16 dwt. At E the 4 beds of banket are in descending order 4 inches, 4 inches, 3 inches, and 2 inches thick, and their values respectively are 19 dwt., 0 dwt., 9 dwt., and 81 dwt. At F the 4 beds of banket are in descending order, 20 inches, 5 inches, 11 inches, and 3 inches thick, and their values respectively are 2·6 dwt., 1 dwt., 6 dwt., and 19 dwt. At G the banket is in two beds, of which the upper one is 12 inches thick, and contains 12 dwt., and the lower is 21 inches thick and contains 4·6 dwt. Scale 1 inch = 5 feet.

FIG. 14.



SECTION ALONG 20 FEET OF THE MAIN REEF LEADER IN THE NEW GOCH MINE. The Leader increases from 2 inches thick at A, where its value is 36 dwt. per ton, to 4 inches thick at C, where its value is 162 dwt. per ton; at B the value is 16 dwt per ton. At A the Leader lies between beds of quartz, etc., and shale; the shale thins out at the other end of the section, and is replaced by a bed of Bartard Reef which at C is 36 inches thick, and has the value of 1 dwt. per ton. The value of the whole stoping widths are A 5½ dwt., B 3·9 dwt., C 30 dwt. Scale 1 in. = 10 ft.

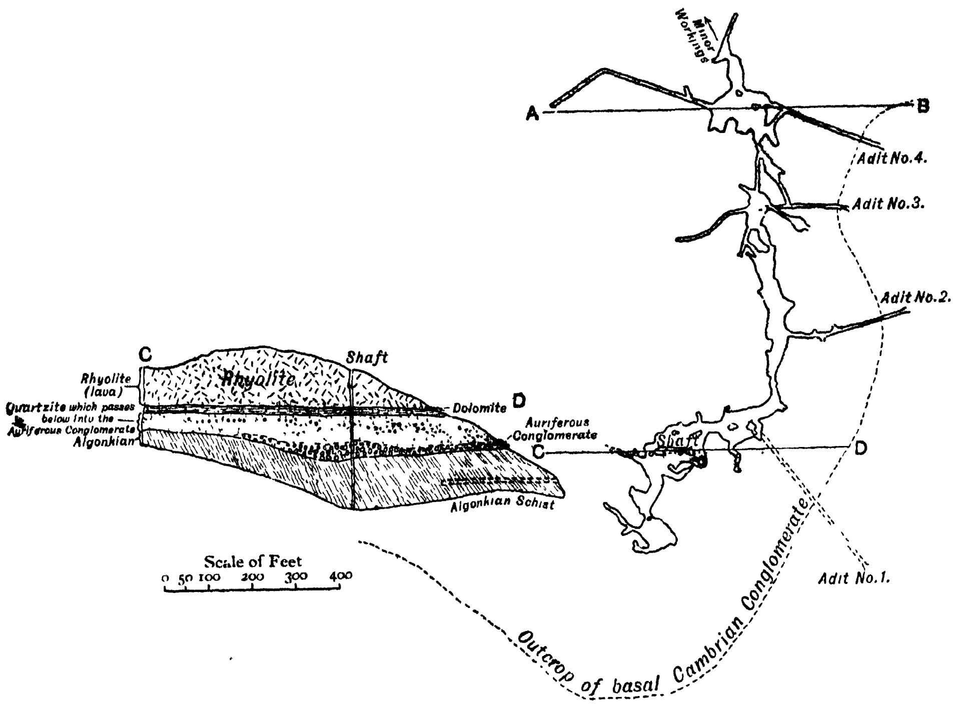
PRACTICAL VALUE OF DETERMINATION OF ORE GENESIS.

It is mainly from its bearing on ore genesis, however, that the microscope is an invaluable aid to the miner. It prevents him from being misled by those false analogies between different mines, which have been the cause of the disastrous failure of so many mining enterprises. The practical value of the determination of how an ore has been produced is now being generally recognised, and it may be illustrated by the following example.

At Bendigo the quartz veins were found in big "V" shaped masses, which rapidly thinned out below till they disappeared. The quartz was in isolated blocks which appeared to be distributed irregularly through the country rocks. The quartz blows exposed on the surface disappeared at slight depths; so it was thought that the field was practically worked out, all its lodes being shallow. The gold yield fell from 500,000 ozs. a year to only similar positions recur one below another in vertical series.

Where a saddle reef is found, another saddle reef will probably occur below it, between some deeper layers of sandstone and slate. So the discovery of the lower saddles of quartz is not left to chance; their distribution instead of being capricious as had been feared, is quite regular; and when one saddle has been exhausted, a deeper reef may be found

FIG. 15.



PLAN AND CROSS SECTION OF THE HAWKEYE-PLUMA MINE, in the Gold-bearing Cambrian Conglomerate of S. Dakota. (After J. D. Irving.) The deposit is in an ancient river placer.

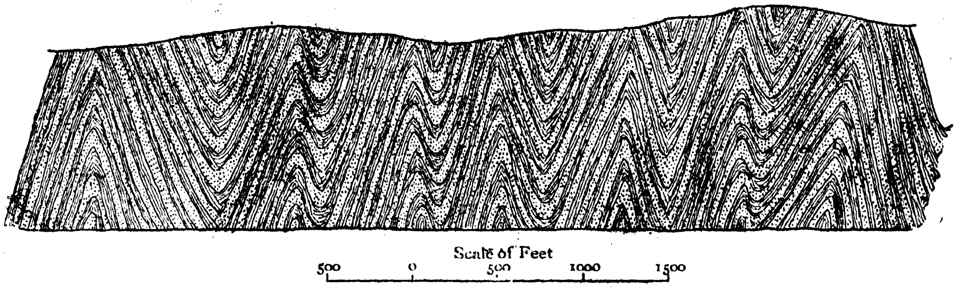
137,964 ozs. in 1890. It was noticed, however, that many of the quartz veins were parallel to the bedding of the slates and sandstones of which the goldfield is composed, and that neighbouring quartz veins sloped in opposite directions. The wedges of quartz were, in fact, only the tips of arch-shaped folds of quartz, each of which rested on an arch of slate, like a saddle on the back of a horse. So they were called saddle reefs. A saddle reef was often found between a band of sandstone and of slate, on the summit of an arch-like fold; and as the country consists of alternate layers of slate and sandstone folded together, beneath it by sinking along the line of what is called "centre-country." Thanks to the guidance of this principle, the Bendigo Goldfield has had a new lease of life; it is the most prosperous of Victorian goldfields, and, instead of its mines being all quite shallow, they have been worked to the depth of 4,250 feet, and are the deepest mines in the world working gold-quartz lodes.

The neighbouring goldfield of Ballarat furnishes another illustration of the valuable guidance to practical mining given by recognition of the genesis of the ores.

In Ballarat East, the hills are composed

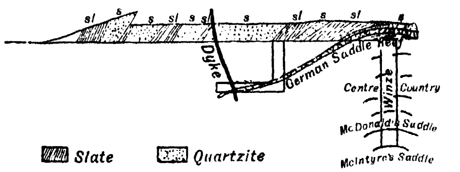
mainly of slates, which are seamed in all directions by quartz veins; so irregular are they, that the miners declared that there were no true lodes in the goldfield—only a tangle of useless veins. The quartz in these veins was mostly barren, but the miners were tempted again and again to prospect them, as they had certainly yielded the great gold nuggets for which Ballarat is famous. The efforts as a whole were unsuccessful, but the miners were occasionally rewarded by the discovery of rich patches or nuggety masses of gold; the distribution of these rich patches appeared so capricious that it seemed useless to search

FIG. 16.



SECTION ACROSS THE CASTLEMAINE GOLDFIELD. Composed of contorted slates and quartzites, wit which are associated bedded quartz veins developed as saddle reefs. (After W. Baragwanath, Jnr.)

FIG. 17.

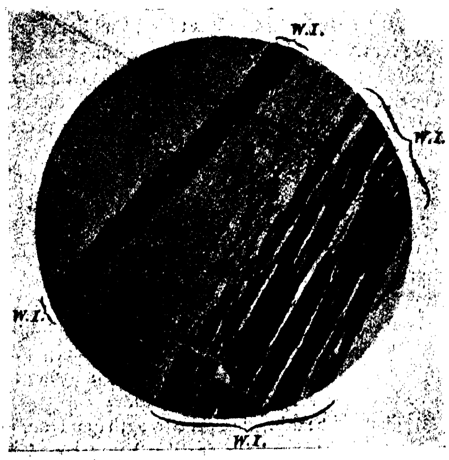


A SADDLE REEF IN THE CARTLEMAINE GOLDFIELD. (After W. Baragwanath.)

for them. But at length the clue to their distribution was discovered. The slates are traversed by numerous secondary seams of chloritic minerals, produced along planes of what is known as slip-strain. (Fig. 18.) The chloritic minerals, when decomposed, give rise to materials which can precipitate gold from its solutions.

Where one of these seams meets a quartz vein, a rich patch of gold often occurs at the point of intersection, whereas a few inches away on either side the quartz is quite barren. The chloritic seam continues beyond the quartz vein, and at its intersection with the next quartz vein there may be another nuggety patch of gold. These narrow seams are found, in fact, to lead to the points where the gold is concentrated in the quartz veins. Hence, as they indicate where the rich gold was found, they are called indicators, and many of the mines of Ballarat East have been worked successfully by following these seams from one rich patch of ore to the next. The whole of the gold in the area is not found on these indicators, for much of it comes from veins and

FIG. 18.



A MICROSCOPIC PHOTOGRAPH OF A THIN SECTION OF THE WESTERN INDICATOR OF THE BALLARAT EAST GOLDFIELD, enlarged 15 diameters. The indicator consists of thin lenticular patches of chlorite, formed along the planes of slip-strain cleavage.

masses of quartz along faults. But in a critical period in its history, the field was saved by the discovery how to use these indicators in the search for the rich nuggety patches of gold.

These instances show the necessity of the detailed geological study of mining fields; for two of the most important goldfields in Victoria, of which one was thought to have only shallow ore-bodies, and the other to have no lodes at all, have been successfully developed since the discovery of the plan of their gold distribution. So long as it was believed that no better explanation of the distribution of the rich gold patches and quartz masses could be given than in the old Cornish mining proverb, "where they are, there they are," the continued success of those fields was impossible. But now that we know "why they are where they are," the Bendigo mines have been carried down till they hold the existing record in depth of gold-quartz mining.

SMALL OCCUPYING OWNERSHIPS.*

The British land system, namely, that of landlord, farmer, and labourer—which meant three separate castes—has broken down in every other country in Europe, has broken down in Ireland, and is breaking down in England. To it is mainly due our startling rural depopulation. Whilst there was an increase of 12·17 per cent. in the total population of England and Wales at the last census, the dwellers in the rural districts had fallen to less than $7\frac{1}{2}$ millions, or to 23 per cent. only of the whole population.

Those who urge that we must rely on trade and commerce for our prosperity are reminded that the greatest wealth of a nation is its producing power, and that, whilst the producing powers of many other undertakings are becoming more and more difficult, those of the land are not half developed. The conclusions urged are:—

(1) That the policy of placing trade and manufactures above agriculture is a wrong one.

(2) That an amount of capital (including the personal labour of the cultivating owner and his family) properly invested in land yields a far greater return to the community than a similar amount invested in commerce and manufactures.

(3) That, if health, physical strength, and an increase of the population are to be reckoned as national assets, agriculture enriches the nation far more than manufactures can.

(4) That the home trade, resulting from the development of agriculture, is larger, more certain, less fickle, and more valuable than the foreign trade.

Agriculture must not be regarded simply as any other trade, but as the basis of all trades. In France, Germany, and other Continental countries a prosperous agriculture and a consequent numerous and thriving rural population are regarded by statesmen as the two great pillars of the State on which the general well-being of the people rests. They are regarded as the true sources of wealth, as the most effective means to secure a wider distribution of wealth, and as the best guarantees for national stability.

Leaving the larger branches of agriculture—the raising of corn, cattle, &c.—and turning to "small cultivation," we observe that we annually import some sixty million pounds' worth of the smaller articles of food, such as butter, cheese, bacon, eggs, poultry, fruit, vegetables, &c., and that these articles might be wholly or mainly produced at home if our land system were what it ought to be. We have the land, and we have the men standing idle or only partially employed. Many country-bred men now employed in the towns would gladly return to the villages (for which they are better fitted) if adequate and reasonable facilities were offered to them.

As to the land, inquiries show that in Great Britain there are some ten to twelve million acres of permanent grass (apart from the land used for hay, rich meadow land, and land unsuitable for the plough) which could be used by small cultivating owners, and this acreage is annually increasing. These ten to twelve million acres of uncultivated land are for the most part a national loss, and on them profitable employment could be found for at least a million of families, growing produce for which there is an almost unlimited demand. To bring the men and land together is the work of the State, acting through a central department as well as through the local authorities.

Where small ownerships have been tried in this country, under the Small Holdings Act, 1892, they have been eminently successful: cases in point are the small holdings in Worcestershire created by the Council of that county. That Act, however, requires amendment, and some attempts were made by the author this year to get it amended, but they were resisted by the Government.

These proposals are only a part of a complete scheme for recreating a peasant proprietary and yeomen freeholders. Attention is called to a Bill (No. 99) before Parliament this year, entitled the "Purchase of Land (England and Wales) Bill," under which it is proposed (1) that present farm tenants shall be able to purchase the freehold of their land on agreement with their landlords or on its coming into the market, and (2) that the Board of Agriculture shall be enabled to purchase land for "small holdings" for persons who desire to buy, and who will themselves cultivate such holdings. The principle of the Bill is the same as that of the Irish Land Act, 1903. If necessary, all the purchase money is to be advanced by the State to the farmer, to be repaid—interest and sinking fund—by annual instalments. The Bill contains provisions against mortgaging, subdivision, and sub-letting, and thus the occupier is

* Abstract of a paper by the Right Hon. Jessie Collings, M.P., read before Section F of the British Association, at Leicester.

safeguarded from these admitted evils to which all owners are often subject.

It is not contemplated that all the land should pass into the hands of cultivating owners—every kind of tenure would no doubt remain—but that "occupying ownerships" ought to be the governing principle of our land system instead of being a mere incident in it.

To facilitate the carrying-out of the suggested scheme of small occupying ownerships, the author strongly advocates: (1) a better system of rural education, and (2) the establishment of co-operation among the cultivators both for the purposes of buying and of selling. But it is pointed out that co-operation is the natural outcome of small ownerships, but is not readily adopted by yearly tenants, who are often here to-day and gone to-morrow. In conclusion it is claimed that the suggested scheme as a whole would go far to solve the grave social problems of the day—the problems of the "unemployed," "housing," "widespread destitution," &c.—and that to pledge the national credit for the purpose of carrying it out would be in accordance with the principles of a sound national and political economy.

THE THAMES BARRAGE PROJECT.

This scheme has now taken a practical shape, a volume of expert studies, and reports on the various aspects from which such an undertaking may be regarded, having been published by Messrs. Swan, Sonnenschein and Company. These reports deal with the project in its general form, as well as with the moot question of dredging as an alternative method of securing greater depth in the Port of London. The subject of silting and infiltration is discussed by Mr. Clayton Beadle, F.C.S.; draining and pumping from the low-lying lands are dealt with by Mr. E. T. Hennell, M.Inst.C.E.; while the sanitary condition of the river occupy the attention of Mr. W. J. Dibdin, Vice-President of the Society of Public Analysts. As to the main features of the proposed barrage, it may be explained that it consists in the construction of a substantial dam across the Thames at Gravesend, by which the waters of the port would be held up to the level of a perpetual high tide, and the undoubtedly grave inconveniences of the present rise and fall would be obviated. It is well known that the Royal Commission on the Port of London, which reported in 1902, recommended various drastic measures with a view to improve the accommodation of the port, and enable it not only to make better provision for the growing maritime trade of London, but also to prevent rival ports like those of Antwerp, Rotterdam, Hamburg, Bremen, &c., from profiting from the defects and drawbacks of London. One of the chief requirements of the present day is of course greater depth of water for the ever-increasing size and draught of steam vessels, and this the Royal Commission recommend should be met by a gigantic scheme of dredging. It is, however, doubtful whether indiscriminate dredging is entirely feasible and safe, and various witnesses who actually appeared before the Royal Commission testified to the extreme care with which dredging operations in the Thames would have to be conducted to avoid collapse or settlement of river walls, houses, and other riparian property. If, therefore, any danger is to be anticipated from dredging a spacious navigable channel not only to Gravesend, but also from Gravesend to London Bridge, the promoters of the barrage project are probably justified in contending that the solution of the problem would be better approached by adding water to the top rather than scraping earth away from the bottom. In homely language, this is what the barrage proposes to do. Access to the port and exit therefrom are to be provided by means of six locks large enough to cope with any ship seeking shelter within the limits of the metropolitan harbour. Once within the barrage, ships and barges would be free to make for any point they might wish to reach, and would not be dependent as now on the flood to enable them to ascend and the ebb to return. There would thus be a better distribution of the river traffic throughout the day and night and the congestion at the lock entrance at the time of high water would be obviated. The cost of the project is estimated at a little above five millions sterling, but this is of course a small sum compared to the thirty millions or so that the purchase of the docks would entail on the ratepayers of London. Among the probable results would be a great diminution in pilotage and towage charges, less time spent in port, and great saving to the dock companies owing to the abolition of locking in and out, which has been estimated to cost £70,000, and also to the abolition of the need for dredging within the docks calculated at from £30,000 to £40,000 per annum.

It seems reasonable to suppose that these economies will proceed directly from the dockisation of the river, and if so they ought to enable the dock companies to lower their charges, which have been so long a matter of complaint on the part of shipowners and merchants.

There is not space here to review in detail all the results anticipated to flow from the barrage, but there is no doubt that, assuming the feasibility of such a project, there would be undoubtable advantages attaching to it, while the drawbacks and difficulties, seem in some cases less serious than anticipated. As to the financial aspect, this must necessarily rest on a very uncertain basis till the entire scheme has been sifted and investigated by experts. What seems to be required is a public enquiry under the Board of Trade where the calculations, arguments, and opinions of the various professional gentlemen whose reports go to make up the present volume, would be tested and examined. Such an enquiry need not obstruct the progress of the Government Bill for creating a Port Authority, which the President of the Board of Trade has announced

his intention of bringing in next session, and at the same time the results of the investigation would prove of great use to the future governing body of the port. The fact that a similar barrage has been planned and nearly finished in the Charles River at Boston, U.S.A., affords some sort of precedent though no doubt the circumstances of the two cities differs greatly.

THE LYONS SILK TRADE.

The amount of silk conditioned at the Lyons Condition House in 1906 was 15,810,871 pounds, an increase of 356,510 pounds over the year 1905. This increase in the quantity of raw silk was not accompanied by a corresponding increase in worked silk (trams and organzines). During the last quarter of 1906 a speculative fever prevailed in the raw silk trade for future delivery, and principally in Asiatic products. The characteristic feature of 1906 was the scarcity of raw material offered in the market, due for the first quarter to the general short crop of 1905. The large crop of 1906 did not, contrary to all expectations, compensate for this shortness. The entire world's product is estimated by the Silk Association of Lyons to be 45,194,300 pounds, compared with 40,785,300 pounds in 1905. Not counting worked silk (silk thread that has been twisted and is ready for the weaver) the imports of raw silk amounted to 15,667,446 pounds. These figures give adequate idea of the actual amount of business transacted in raw silk by Lyons merchants. They have houses in China, Japan, Syria, and Italy, and they sold to different countries large quantities of raw silk of which no account is made in these statistics. The American Consul at Lyons says that of the total amount handled, 8,000,000 pounds remained in Lyons and were worked into the finished article by the weavers there and in the suburbs of the city. In the matter of manufactured silk it is stated that all the old stock and an increased output were sold during the year. An increase of £1,340,000 in the value of the merchandise sold over the year 1905, and of £680,000 over 1904 is recorded. The activity in sales which commenced in the latter part of 1904 continued through the two succeeding years, the sales being most largely in light goods. The exports of silks from Lyons in 1906 amounted in value to £12,940,000 against £12,200,000 in 1905. The imports of silk for 1906 amounted to £1,600,000 and consisted largely of pongees, corah and tussah from the East, which are dyed and re-exported. The principal purchasers of Lyons silk last year were the United States, the United Kingdom, Germany, Switzerland, Belgium, Turkey, Italy and Austria. Five-sixths of the silk produced in Lyons are exported to England, the United States, and other countries beyond Seas, Continental Europe representing only about one-sixth of the consumers of the principal product of Lyons.

HOME INDUSTRIES.

The Price and Output of Copper. — The heavy fall in the price of copper, and the reasons for it, are matters of great moment to many home industries which have been seriously handicapped for some time past by the high price of the metal. Last week there was a further break of £8 15s. per ton in the price and the quotation finished at £65 10s. per ton, or £45 5s. below the highest of the year, and £18 2s. 6d. below the price in the corresponding week of 1906. Still, even now the mean price of the year is high if the average of the decade is taken, as is seen in the following figures: — Mean price in 1897, £49 6s. 10d.; in 1900, £74 7s. 6d.; in 1905, £72 10s.; in 1907, £82 2s. 6d. The average mean price of the ten years was £66 8s. 9d., or slightly in excess of the quotation at the time of writing. Of course, during the ten years the demand for copper has increased largely, but the output has increased in at least corresponding degree, and probabilities would seem to point to considerably lower quotations. It is noteworthy that the Quincy Mining Company, one of the oldest copper companies in the United States, and able to produce copper at the rate of 10½d. per pound, has felt it necessary to reduce dividends with copper at its present prices. The stocks of copper in hand in the United States are believed to be very large. Consumers would buy if business was active, but it is not. At a recent meeting of prominent American wire manufacturers it was generally agreed that business in recent months had fallen off to something like 50 per cent. Representatives of the brass manufacturers stated that their business had fallen off from 30 to 40 per cent., whilst the sheet copper business was practically at a standstill. It would seem to be much the same in the United Kingdom. Ten days ago Messrs. Lewis Lazarus reported that for the first time during the present fall there was evidence of concentrated selling by the trade, and the standard was pressed for sale wherever a willing taker was to be found. The position of the producer seems to be less strong than was generally supposed, private stocks being in greater quantity than has been generally assumed. The high price of copper has called a halt in certain lines of industry in which copper is usually in much demand, with the result that stocks have not been drawn upon so heavily as was anticipated, and manufacturers, counting upon still lower prices, will not buy at present rates. On the other hand, producers have to finance steadily growing stocks of copper, and that at a time of great monetary stringency. There would seem, therefore, to be grounds for the opinion that probabilities point to still lower quotations for copper before consumers can be induced, or forced, to buy in large quantities.

The Wool Trade.—Reference was recently made in these Notes to the way in which the Australian wool auctions are affecting those of London. Until recently the Australian auctions were of small im-

portance, the bulk of the sales being made in London, but during the last year or two the position has been reversed. During the wool year which ended on June 30, no less than 82 per cent. of the total clip of 1,663,000 bales was marketed in Australia, and it is expected that in the present season this proportion will be increased. On Wednesday next the London Colonial wool auctions begin, and it is expected that about 100,000 bales will be offered; and on Friday the Australian sales commence at Adelaide. More English buyers are said to have left than ever for the Antipodes, and large numbers have gone from the Continent and the United States. Some leading Bradford firms have sent out two, and even three representatives, the duties of a buyer attending the colonial markets being very arduous. Sales will follow each other in quick succession up to Christmas in Adelaide, Melbourne, Geelong, Sydney, and Brisbane, and afterwards there will be auctions at Launceston and Hobart, and the New Zealand markets will open. Meantime the top-makers at Bradford refuse to sell forward. Last year they sold heavily for future delivery. They reckoned upon the large increase in the Australian clip enabling them to secure wool cheaply, but their calculations miscarried. They were right in assuming a large increase in the clip (the actual increase was over 200,000 bales), but they did not reckon with the larger increase in consumption which neutralised the increased supply. Merinos and fine cross-breds not only maintained their ground, but increased in value. It remains to be seen whether the top-makers will better serve their interests this year by assuming the maintenance of present prices. There would seem to be a present probability of a full supply of raw material.

The Cotton Position.—There is more than the usual uncertainty as to the cotton supply. There has been drought in Texas, which, it is estimated, may reduce the yield from that State by a million bales. On the other hand, improvement is reported in other sections, and the planter is eager to sell at the present range of prices all the cotton which he can market during the early part of the season. The crop is undoubtedly late, which increases the danger from early frost, but against this risk is to be put the fear of a general reaction in business of which the decline in iron and copper is held to be an unmistakeable sign. Still, the market for cotton goods in the United States, as in the United Kingdom, shows no sign of serious shrinkage. The reports from Egypt and India as to the prospects of the cotton crop continue good, and if reliance may be placed upon a report just issued, written by the Japanese Resident-General at Seoul, on the cultivation of cotton in Korea, it would appear that that country's contribution to the world's cotton supply is likely to be substantially increased, and improved in quality. Meantime extensive shipments of yarn to the Continent continue. The imports of Germany in August were about double those of the same month last year, and Holland shows an increase of 50 per cent. During the last twelve months the exports from the United Kingdom were 224,810,000 lbs., as compared with 151,481,000 lbs. in the corresponding period of 1903-4. The annual holiday in the weaving mills of Lancashire, which has been longer than usual, is now over, and it is expected that the fine counts wages question will come up for discussion almost immediately. It is by no means certain that an arrangement will be arrived at. The operatives are believed to be in an uncompromising mood, which, if persisted in, may lead to a strike that with reasonable give and take might be avoided.

Shipbuilding and the Price of Coal. — At first sight it is not very apparent how the shipbuilder can be greatly affected by the present rise in the price of coal, great as it is, but in fact it is a very serious matter to him. If the shipbuilder is not a large consumer of coal either in the yard or the engine shop, he is amongst the largest consumers of iron and steel. The cost of finished iron and steel is seriously affected by the increased cost of coal. The chairman of the Steel Company of Scotland, Limited, has recently explained to the shareholders of that company how the prospects of the steel trade have been darkened by the rise in the price of fuel, and the cost of production of iron and steel is being increased at a time when reaction in America and Germany point to a lower range of prices. No industries will suffer more than the iron and steel from the rise in the price of coal, and dear iron and steel affect no trades more closely than those concerned with shipbuilding. If regard is had to output alone the shipbuilding record of the present year is highly satisfactory. In the seven months ended July 31 the output of the United Kingdom was 556 vessels of an aggregate of 943,016 gross tons. It is true that so far as tonnage goes these figures show some decline upon those of last year—943,016 tons as against 991,092 tons—but the vessels numbered 556 as against 461, and last year included the *Lusitania* and *Mauritania*, each of 32,000 tons, and quite exceptional in character. Apart from 1906 this year is much ahead of all records so far as output goes. If the August output is included, and the comparison is confined to the Clyde, that of the present year exceeds that of 1906, being 459,763 tons as against 449,772 tons, and excepting 1906 the output for the eight months greatly exceeds that of any other similar period on record. The new contracts of the eight months showed considerable contraction although for the month of August they were unusually good. September and October are generally active contract months but they will hardly be so this year with the rising market for coal and iron. Steelmakers must now ask higher prices for shipbuilding material than they were ready to sell at a short time ago. The peaceful settlement of the labour disputes which at one time threatened a serious crisis is a matter for

congratulation, but this year can hardly be a very profitable one on the whole for shipbuilders. The outlook for the men is better than it promised to be earlier in the year, for the new orders are sufficient to maintain active employment in many of the yards during the winter. But in order to keep the yards employed, shipbuilding and engineering employers have had to cut contract prices very low, encouraged thereto by the anticipation of a general decline in iron and steel material. They did not reckon with the rise of coal, due to the large export demand.

Wages in the Clothing Trade.—Statements made in a case in which a man was charged with begging have led to some misapprehension as to the rate of wages paid in the clothing trade. The accused alleged that he was a tailor's presser out of work, and had recently been engaged in finishing trousers at 1¾d. a pair. It seems poor pay, but the facts do not justify the newspaper heading, "Trouser-making at a Penny Three-farthings a Pair." There is a wide difference between trouser-making and finishing. Nowadays, no individual makes a pair of trousers, at any rate it is not the practice in the trade. What is known as "finishing" is neither a long nor a difficult job, and an average hand can, it is said, finish a pair in ten minutes. Assuming this to be correct, as experts say it is, the remuneration works out at something over tenpence an hour. The clothing trade attracts much unskilled labour, and women as well as men without any knowledge of tailoring enter the factories. When they are industrious and willing to learn they can earn a living wage, but many of them do not come under this category.

Hematite Iron. — The cessation of all demand from America, and the partial stoppage of Continental orders, have caused a great falling off in the demand for hematite iron, and North-West of England smelters have reduced their nominal figures to 80s. per ton net f.o.b. Warrant iron is at 76s. per ton, with indications of lower prices. The home demand remains good, but the shrinkage of the foreign demand necessitates some restriction of output, although orders in hand are expected to keep things active for another three months. Stocks at the end of last week stood at only a little over 10,000 tons, the lowest point touched for many years. The shipments of iron and steel during the last weeks show a heavy falling off, but the aggregate shipments of the year are largely in excess of the corresponding months of 1906.

GENERAL NOTES.

BANANAS IN FRANCE.—It is astonishing, says Mr. Consul-General Hearn (3283-152), in reporting on the trade of Havre, how popular bananas have become in France. Not so long ago the banana was a rarity; now it is to be found hanging up in every fruiterer's window. The bulk of the bananas consumed in Europe are imported from the Canary Islands by British firms. The West Indian banana does not appear to have reached the Continent in any great quantity as yet. In 1877 only 5,000 bunches of bananas were imported into France; this rose in 1901 to 50,000 bunches, and in 1904 to 250,000 bunches. Paris takes about half the quantity, and then the two chief consumers are Marseilles and Bordeaux. The wholesale price of a bunch is, on the average, 12s. 6d. The bananas are sold retail at three sous a piece, and as there are from 150 to 200 bananas on each bunch, that price brings the retail price of the bunch to from 16s. to 20s., which gives a profit of from 4s. to 8s. per bunch. The bananas sold in the South of France and Algeria, although sold under the name of Dahomey bananas, as a rule all come from the Canaries. The highest prices are obtained in the spring and autumn. Before France, encouraged by the high prices she has to pay for her bananas, takes to growing them herself in the many colonies suitable to their cultivation, it would be well, Mr. Hearn thinks, for British firms to stimulate the importation and taste for Jamaican and other West Indian bananas, which, in his opinion, are finer than the Canary fruit.

BELGIAN CEMENT.—In his report upon the trade and commerce of Belgium, just issued (Cd. 3727-1), Consul-General Sir Cecil Hertslet again directs attention to the systematic habits of the dealers in Belgian cement in passing off their productions of inferior quality as an article of British manufacture, or British origin, at exceptionally low prices, which cannot be approached by makers in the United Kingdom so long as they retain the high standard for which British cement is famous. Sir Cecil Hertslet says that the blame cannot be put so much upon the Belgian manufacturers themselves as upon the commission agents, and dealers of that class, who furnish any labels that may be required to the makers to attach to the barrels or casks when forwarded from the works, many of which labels are undoubtedly infringements of trade marks of makers in the United Kingdom. It seems to be difficult for the British manufacturer to trace the fraudulent imitations which are being passed off under his particular brand in the colonies and foreign countries. It would seem, however, that buyers are beginning to realise that much of the cement manufactured in Belgium, described as "Portland" cement, and having British names and brands, is not the genuine article, but is in every sense inferior to the British production, and in many cases is not entitled to be called "Portland" cement at all, according to the accepted standard. Of late there has been considerable reduction of Belgian exports of cement to the United Kingdom and British colonies.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The programme for 1908 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. (post free 4d.) Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The subjects include:—Book-keeping, Accounting and Banking, Shorthand, Typewriting, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 6, 1908.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates will be given; in Harmony Higher, Intermediate, and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments nf Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the programme.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

GOLD MINING AND GOLD PRODUCTION.

By Prof. John Walter Gregory, D.Sc., F.R.S., F.G.S.

Lecture III.—Delivered February 11, 1907.

III.—Gold Extraction, the Variations of Mines in Depth, and the Gold-mining Industry.

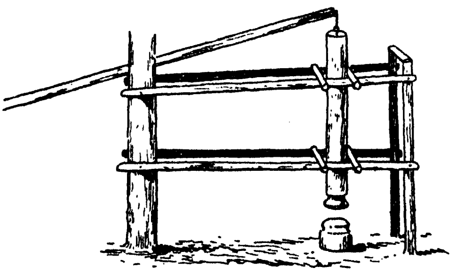
The fame of Rudolph Eric Raspe as the author of "The Surprising Adventures of Baron Munchausen" has eclipsed his former infamy as a mining adventurer. During his varied career Raspe found himself in Scotland, where he raised £30,000, with which to exploit some vast mines of mercury that he claimed to have discovered in the north-western Highlands. To promote his scheme and increase his own authority on the matter, he published in 1791 an English translation of Baron Inigo Born's valuable work, "The New Process of Amalgamation of Gold and Silver Ores;" for Raspe maintained this process would lead to an immense demand for mercury, as with it, gold could be obtained from rocks which had hitherto yielded none. Any Scotch mercury mines that there may be, are however still unworked; for Raspe and the £30,000 passed silently away to other fields of activity.

The use of mercury for collecting alluvial gold is very ancient, as it is mentioned by Pliny; but it was apparently not until 1566, that it was found that the process of amalgamation would extract gold and silver from other ores. This discovery, made in Mexico by a Spaniard, Fernandez de Velasco, opened a new epoch in the history of gold-mining; for it supplied an economical method of extracting gold from ores, whence it could not be recovered by washing.

The Stamp Battery.

The ancient method of working gold-quartz ores was to break the quartz into coarse fragments and then grind it to powder between a hard stone and a flat surface of rock, like an ancient corn mill. The underlying rock is worn away, forming a groove, in which the broken quartz can be mixed with water and thus washed while it is being ground. Such simple hand quartz mills may be seen beside some of the old mines in Rhodesia, and the grinding stones, balls of a tough diorite, are found beside them. This simple hand mill is the most primitive form of quartz crushing machine. The second device was probably some kind of pestle and mortar, which, in the form of the hand dolly, a strong iron pestle and mortar, is still used in prospecting and sampling. The passage thence was easy to a pestle work by a lever, such as is still used by the Chinese in the Northern Territory of South Australia.

Fig. 19.



A Primitive Stamp. Still used by the Chinese Miners in the Northern Territory of South Australia. (After Basedow.)

Gradual increase in the size and complexity of the mechanism led in time to the German mill, which was developed in Germany at the beginning of the sixteenth century in order to crush the ores of the Erzgebirge and the Harz Mountains. It is illustrated in the excellent figures in Agricola's "De Re Metallica," published at Basle in 1556. The German battery may still be seen and heard in this country in the Cornish tin mines. It consists of a broad flat-footed pestle, called a shoe; the pestle is lifted by a projection on a revolving shaft, and falls by its own weight upon fragments of ore. At first the ore was pounded upon an open floor and was crushed dry, but the advantages of enclosing it in a box and washing it at the same time were obvious, and Agricola's book shows also an improved battery provided with a mortar-box. These batteries were worked by men or horses, but generally by water power. The German battery remained the best thing in quartz-crushing machinery until it was taken in hand by the miners of California, who improved it into the modern stamp battery. The Californian battery differs from the German by having circular pestles or stamps, which are rotated while being raised so that the striking face of the stamp is worn evenly. The stamps are lifted by cams fixed on a revolving shaft, they fall on to dies in the mortar-box, and the ore is smashed between the stamps and the dies. (Fig. 20, p. 1039).

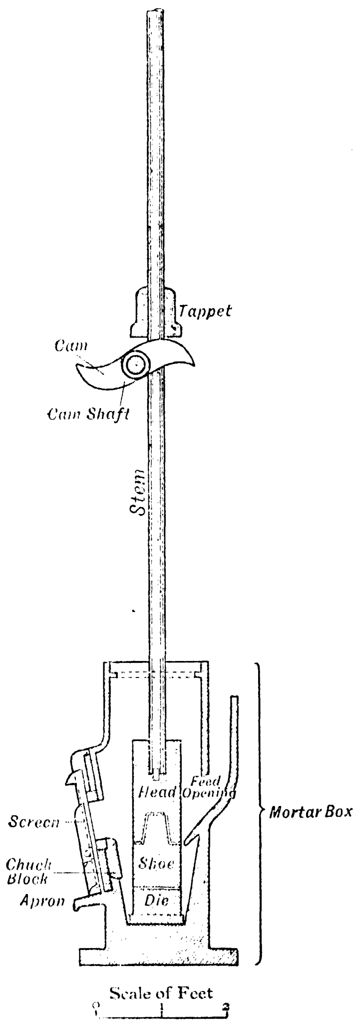
The stamps are usually grouped in sets of five, each set in one mortar-box; the sets are arranged in series, each of which, in large mills, usually includes fifty stamps. The greatest number in any one mine is at the Homestake in South Dakota, which has a mill of 1,000 stamps, and even larger mills are proposed on the Rand.

The ore may be fed into the mortar by hand or automatically; the finely crushed ore or "pulp" is splashed about in the mortar-box, where it comes in contact with the mercury usually kept there. This mercury catches some of the gold, and more is caught on the "chuck block" in front of the screen, through which the pulp escapes from the mortar. This "inside amalgamation" is, however, not always used. How much of the gold it is wise to collect in the mortar-box depends on many factors which are not all mechanical. One important consideration may be the theft of amalgam if left exposed on the plates. On the Rand this loss has been described as a severe tax on the mining industry. At Mysore it is found advisable to crush the ore extremely fine, in order to collect most of the gold inside the mortar-box, where it is less exposed to thieves.

All branches of mill management have been discussed in great detail. The best order in which the stamps should fall, for example, has quite a literature of its own: and there is no

doubt the efficiency of the battery can be greatly increased by a suitable order of the fall of its stamps. There has also been prolonged discussion and experiment as to the best arrangement of the screens. They are used of different heights, and there has been much controversy as to whether it is

FIG. 20.



CROSS SECTION (Scale ½ inch to 1 foot) THROUGH A STAMP AND MORTAR-BOX.

better to have the screens vertical, as is usual in Australia, or to have the upper side inclined outward, the usual American practice, which is adopted also in Mysore and South Africa.

There are many types of stamp battery, which differ in very important respects. During recent years the stamps have been increased in weight from four hundredweight to 1,500 lbs. At the same time, the number of blows struck per minute has been increased by reducing the fall of the stamps to from six to nine inches, and it is thus possible to give them a more rapid action, each stamp falling perhaps one hundred times a minute. The desire for still greater speed has led to more fundamental changes.

The more blows a stamp gives, the more ore it will crush in proportion to its weight; hence it is desirable for a small mine, to which transport is very costly, to drive its battery as quickly as possible. Accordingly the efficiency of the stamps has been increased by batteries in which the blow of the stamps is not due to gravity alone. In mills of the Tremain type, which have been used with success in Rhodesia and West Africa, the stamp is both lifted and driven down by steam; and thus a light two-stamp mill will do more work than a heavy five-stamp gravity battery.

A quicker action can also be obtained, as in the Morison battery used at the Meyer and Charlton Mine, Johannesburg, by working the stamps by cranks, whereby 1,600 lbs. heads are driven at the rate of 130 blows a minute, and crush quartz at the rate of ten tons a day.

A second line of reform raises the crushing power of the battery by increasing the rate of discharge from the mortar; this can be done by enlarging the area of the screens through which the pulp escapes. One method is to have screens on both the front and back of the mortar-box; but this reform has not found general favour, though it has been used at many Australian mines with good results. The extreme development reached on this line is the Merrall Mill. (Fig. 21.) In that machine each stamp works in a separate mortar-box, which has a screen on each of its four sides; hence the discharge is naturally much quicker than when the material is discharged only through one front screen.

Another and still more revolutionary change in ore crushing is following from the need for the very fine crushing usually necessary for cyanidation. This reform may, therefore, be considered after reference to the methods of gold extraction from the crushed ore.

GOLD EXTRACTION.

The processes of gold extraction may be divided into four main groups—amalgamation, smelting, chlorination, and cyanidation.

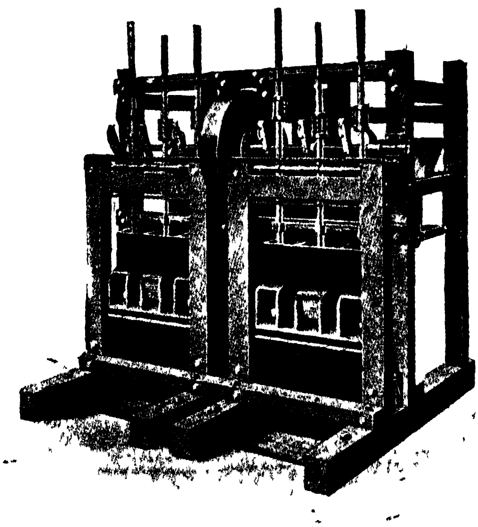
Amalgamation depends on the power of mercury to combine with gold to form an amalgam. The process is applicable to ores

carrying free gold, even though it may be completely enclosed in pyrites; as it then usually occurs free in cracks or cleavage planes in the pyrites, and thus can be recovered, if the ore be ground sufficiently fine for the mercury to come in contact with the gold.

Amalgamation may be begun in the mortar-box; the rest takes place on sloping copper plates, rubbed with mercury, which are situated in front of the battery.

Battery amalgamation cannot recover all the gold. The gold contained in fragments of pyrites, "amorphous" gold, gold that has been over hammered, and any covered with oil or slime, all escape amalgamation. Such

FIG. 21.



MERRALL STAMP BATTERY.*

gold and gold-bearing material has to be collected by some process of concentration into "concentrates." They may be obtained by washing the pulp from the battery down a long channel, and collecting the heavier material by riffles, or on the rough surface of strips of canvas or blankets on the floor of the channel; or the material may be sorted according to the specific gravity of the particles on revolving tables known as buddles; or on shaking tables (vanners and the Wilfley); or by "sizing" the materials by currents of water through such appliances as pointed boxes (Spitzkasten).

The concentrates thus obtained may be ground in Californian mills or Berdan pans, and then amalgamated. Some concentrates, however, do not yield their gold by amalgamation, and require more complex chemical treatment. The oldest method was smelting, and this may still be advisable for some refractory sulphides and tellurides, such as some of the ores at Cripple Creek and Kalgoorlie. Economic smelting requires a mixture of different types of ores, which are not usually found in the same mine or mining field; so it is conducted in special smelting centres, such as Denver—which collects the various ores of Colorado—and Swansea and Freiberg, in Saxony, which smelt ores received from world scattered mining fields.

Smelting is of less importance in dealing with gold ores than the chemical processes of chlorination and cyanidation.

The chlorination process is due to the work of Percy, in 1846, and of Plattner, in 1848. It is an application of the power of the gas chlorine to combine with gold forming auric chloride which is soluble, and can thus be leached out of the altered ores. The formula representing the process is:—

$$3\,Cl + Au = Au\,Cl_3.$$

The gold can be precipitated from the auric chloride solution by charcoal, iron, ferrous sulphate, &c. The process is applicable to many complex ores, and is used, for example, at Cripple Creek, and in dealing with pyritic concentrates in many fields; but it has been superseded to a great extent by the younger and simpler process of cyanidation, which has the advantage of not requiring the roasting of the ore.

The Cyanide Process.—The cyanide process is due to MacArthur of Glasgow. It depends on the fact that a weak solution of cyanide of potassium will disolve gold in the presence of oxygen as auro-cyanate of potassium.

$$Au_2 + 4\,K\,Cy + O + H_2O = 2\,K\,Au\,Cy_2 + 2\,K\,HO.$$

The gold can be recovered from the solution by precipitation with zinc or electrically by the Siemens-Halske process. There are many variations in cyanide practice in accordance with the varying nature of the ores. Some American mines and the Great Boulder Proprietary Mine at Kalgoorlie use sodium cyanide instead of potassium cyanide. Bromocyanide is added to the vats as well as potassium cyanide in treating the telluride ores of Cripple Creek and some of the mines of Kalgoorlie (the

* This block is kindly lent by the Sturtevant Engineering Company.

Lake View Consols, Oroya Brownhill, and Kalgurli mines).

The cyanide process is very simple and economical. It is generally used after the coarse gold has been separated by amalgamation. The crushed material that is carried over the copper plates of the battery is called the tailings. If the mine is in a hilly country, the natural slope of the ground is used so that the tailings can be carried through the various tanks by gravity; but in a level country, such as the Rand, the tailings are lifted from the battery by a high tailings-wheel to a platform, which gives sufficient fall for a current of water to carry the material through the remaining stages of the separation.

The tailings consist of sand and of fine material of the consistency of mud, which is called slime.* The sand and slime are separated by two sets of separators, the "spitzlutten," and the pointed boxes or "spitzkasten"; from them the light slimes are carried off at the top and the heavy sands from the bottom. The heavy materials collected by the first separators are known as the "concentrates"; and they may be ground up and the gold extracted by mercury, or they may be treated by the chlorination process.

The rest of the sand passes into huge tanks, wherein it is allowed to soak for some days in a weak solution (usually ·1 per cent.) of cyanide; or it is stirred up with the cyanide in tanks by agitators. The gold is dissolved and the solution drawn off from the bottom of the tanks and passed to the extractor house.

The slimes are mixed with lime, which coagulates them, so that they settle while most of the water runs off clear. The settled slimes are then stirred up with cyanide, their gold is dissolved, and this solution also passes on to the extractor house. There the various cyanide solutions are run into extractor boxes, and the gold precipitated. Zinc is the usual precipitant, and the gold is collected from the precipitate by smelting in a furnace with a flux, such as one of borax, sand, and bicarbonate of soda, or of borax, sand, and manganese dioxide. An electric method of precipitation is sometimes used instead. The barren slimes from the cyanide tanks are allowed to run away if there be a natural fall, or they may, as at Kalgoorlie, be stacked by a tailings elevator, and ultimately used to fill up the excavations in the mine.

* Its particles are of a diameter of not more than ·002 inch in diameter.

FINE CRUSHING—THE TUBE MILL AND FILTER PRESS.

This invaluable cyanide process was at first used to supplement the other processes, but it has to a large extent supplanted them, and threatens to do so still more in the future. It had one difficulty from which at first there seemed no escape. Dilute cyanide is only an effective solvent for porous or very finely crushed ores; it therefore requires the fine crushing of the material subjected to it. But ore ground so finely that all its gold can be recovered by cyanide is as impermeable as mud. The resistance to the entrance of the solution can be overcome by stirring the slime and solution together in agitating tanks. But when the fluid has got in, the mud takes such a firm hold of it that the gold solution will not drain out. Out of this dilemma Australian mining led the way.

The first process was to improve the system of crushing the ore. The stamp battery is not a suitable instrument for the breaking up of big blocks of stone, for they are apt to tear and smash the screen. Again, the battery is not economical in very fine crushing; for, unless the supply of water, the power, and the size of screen be perfectly adjusted, the stamps waste their power in pounding fragments of quartz in a yielding mass of soft sand.

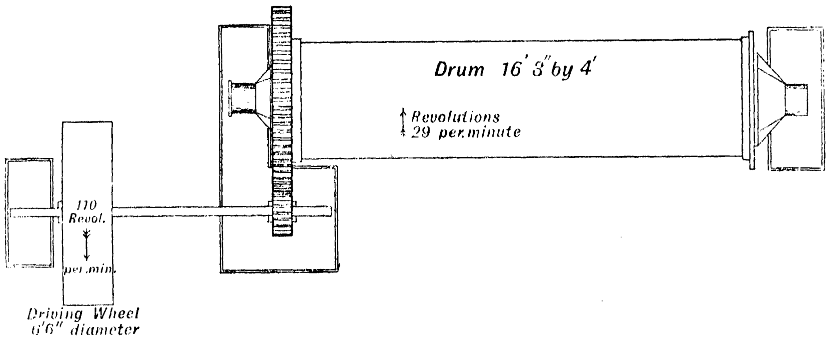
Accordingly, the battery wanted help on each side of it, so that it may be confined to the work for which it is most effective. The ore is therefore broken into fragments of suitable size by rock breakers. The ordinary type of crusher used for breaking rocks into road metal are employed for this purpose; the ore may be crushed between powerful jaws, or by a gyrating steel cone inside a massive steel funnel. The material can be passed through series of rock breakers, each breaking to a smaller size; and instead of this tandem arrangement there may be a compound crusher, such as that of the Sturtevant Engineering Company. The ore is thus reduced to the size most suitable for the battery to deal with it.

The use of rock breakers has long been adopted in many mining fields; but the relief of the stamp battery by the use of special fine grinding appliances has been more recent, and has been productive of more important consequences. The first step was to relieve the battery of the finer crushing. The mesh of the battery screens was enlarged so that the ore escapes as sand instead of as slime, and each stamp therefore crushes much more

ore than it would otherwise do. The Waihi Mine, for example, increased the output of its batteries 30 per cent. by enlarging the mesh of the screens from 40 holes to the linear inch to only 20 holes. And according to Chester's experiments, when the Rand ore is crushed through a 10-mesh screen, each stamp will crush 9¼ tons a day; whereas the same battery with a 30-mesh screen crushes only 4·64 tons a day. The stamps of the miner, like the mills of the Lord, grind slowly when they grind exceedingly small.

The material that escapes from the mortar-box through these coarser screens passes over amalgamation plates which collects the larger particles of gold. The sands had then to be reduced into slime by some instrument better adapted for fine grinding than the battery.

FIG. 22.



PLAN OF A TUBE MILL as used at the Lake View Consols Mine, Kalgoorlie.

Various forms of accessory grinding machines have been employed, such as the Huntingdon mill, the grinding-pan, and the ball mill, but the most famous now is the tube-mill. This machine was developed in cement works to grind up soft limestones. The limestone is fed into a revolving cylinder, and churned up with hard flint pebbles which act as millstones, and grind the limestone to slime.

This machine, variously known as the tube-mill, the flint-mill, or the grit-mill, was introduced into gold mining at Kalgoorlie where it was well suited to the soft tough ores of that goldfield.

A diagram of the larger tube-mills used at the Lake View Consols Mine is given in Fig. 22. It consists of a revolving drum, 16¼ feet long by 4 feet in diameter; it is lined with manganese steel plates one inch thick; they are used until they are worn down to a quarter or an eighth of an inch in thickness. The drum is half filled with a load of rounded flints weighing about 4½ tons; some 35 tons of sands are run into it. The mill is rotated at the rate of 29 revolutions per minute, and the flints grind the sand into fine slime. The mill is mounted on two hollow trunnions through which the ground material is carried away by a stream of water. The fine slime flows to the separating tanks, and the coarser material is returned to the mill. About 300 tons of ground ore pass through the mill in a day, and some of the material goes through it eight or ten times before being reduced to slime. The flints are gradually worn away. The tube-mill, illustrated by Fig. 22, consumes 1,000 lbs. of them a month. The flints may remain in mills where they are completely destroyed; but it is sometimes the practice, as at the Oroya-Brownhill Mine, to sift them periodically, and reject all those that will go through apertures of 1½ inches diameter, as they are found to contribute little to the grinding, while they use up power.

The slime from the tube-mill flows into tanks, where it is stirred up with cyanide solution by revolving agitators; the finest gold is therefore dissolved; but no process of natural draining will extract all the solution from the slime.

Recourse is therefore had to Dehne's filter-press. The slimes may be roughly drained, and placed in layers between sheets of cloth in a press, or they may be pumped into it by a plunger pump. Weak cyanide solution is forced through the press to dissolve any remaining gold, and then the solution is washed out of the slime by a current of fresh water driven through the press by a force pump.

This combination of fine grinding and the filter press has given increased scope to the cyanide process, for it renders possible the

almost complete extraction of the gold from slimes. South Africa has recently adopted tube mills with characteristic enthusiasm, and thereby gained increased profits by extracting gold which would otherwise have gone to waste. But meanwhile in Australia their use has been reduced on the ground that they are extravagant of power. They have been discarded at the Ivanhoe Mine for example, and grinding pans used in their stead. It is held by many Australian miners, and by Messrs. G. A. and H. S. Denny from their South African experience, that grinding pans do the same work as a tube-mill, and more cheaply. According to the results of one set of experiments, 30 horse-power applied to a grinding pan does as much work as 70 horse-power in a tube-mill. The Australian experiments have been severely criticised, but the miners who first realised the value of the tube-mill may probably be trusted to treat it fairly in their tests.

The policy for which the tube-mill was introduced is unquestionably sound, and will be continued; but it is possible that the tube-mill itself has not come to stay, and may be replaced by some more economical machine. The filter press also is being attacked in Kalgoorlie, and the Ridgway Atmospheric Slimes Filter is claimed to do its work as efficiently, while it is more convenient, as it acts continuously and automatically.

Suggested Abolition of the Battery.—The great development of cyanidation rendered possible by these reforms is threatening the abolition of amalgamation and even of the stamp battery. In some places the battery has been abandoned in order to save water. The battery is a very thirsty instrument; it uses on the Rand, according to Mr. G. A. Denny's estimate, ten tons of water to crush one ton of ore. The system of dry crushing reduces the consumption of water, and avoids the use of amalgamation. The ore is ground between rollers or in pans, and then passed at once to the cyanide tanks. This system was once employed at Waihi, in New Zealand, and may be seen in use at the Wanderer Mine in Rhodesia, where the broken oxidised ore is readily permeable, and the gold is extracted at a total cost for mining and milling of 6s. 9d. per ton.

The most advanced attack on the battery is that proposed by Messrs. G. A. and H. S. Denny, and to some extent adopted in the very original plant erected by them at the New Goch Mine, Johannesburg. The battery is fed with cyanide solution instead of water, and the ore is kept circulating in cyanide throughout its course through the separating plant. The gold is all dissolved during this circulation, and there is no need for huge cyanide tanks and special agitators. In the New Goch Mill the ore is broken to fragments in rock breakers, then crushed to sand in a stamp battery; next it was ground to slime in tube-mills, which have, however, been replaced by grinding pans. The gold solution is extracted from the slimes by filter presses.

The logical development of this system, with its restriction of the work of the battery by rock-breakers on one side and all-sliming by fine grinders on the other, and the abandonment of amalgamation, is the abolition of the battery altogether. And this revolutionary proposal the Denny Bros. have already advocated. They recommend the crushing of the ore in a series of rock breakers; the reduction of all of it to slime in grinding pans; its continuous treatment by cyanide as it passes through these machines and from one to the other; and the treatment of the slime in filter presses.

Threatened institutions however live long; and it may be long before the resounding roar of the stamp battery ceases upon the goldfields, although that machine has already lost the monopoly of ore crushing which it so long enjoyed.

Gold Yield of 1906.

The gold supply of the world is now unprecedented; and is apparently still growing. The total yield for 1906 is estimated at over £80,000,000 which is the highest on record, and twice as great as in 1896, and four times as great as in 1886, or only twenty years ago.

This great yield has been contributed by 46 countries, of which the three chief producers are the Transvaal with a yield of £24,579,987, the United States with a yield of £19,431,040, and Australia with a yield of £16,570,312. The Australian output, to which the State of Victoria has been contributing for 56 years, shows the baselessness of the old fear that gold mines are all necessarily shallow. Some ore shoots are certainly limited in depth; but others go down deeper than it will probably pay to follow them for years to come.

Variations of Mines in Depth.

The future of any goldfield depends on the depth to which its ores will continue; opposite opinions have been freely expressed as to the depth to which gold ores may extend. Both

views are locally correct. There may be two adjacent mines, in one of which the ore shoots may be shallow, in the other they may continue downward for thousands of feet. This difference is not a capricious accident, but is the result of definite ascertainable causes.

The once prevalent belief in the shallowness of gold deposits was largely the result of the unquestionable fact that, as a rule, gold veins become poorer and less profitable to work as they are followed deeper. The outcrop of a lode is the easiest and cheapest part of it to work for many reasons. The ore is decomposed and soft, and contains many cavities, so that it is easily mined; a block of it weighs less than an equal sized block of deeper ore; the gold is usually visible to the naked eye, and is very conspicuous in the rust-red ore. In the deeper levels, on the other hand, the ore is compact, hard, and heavy; the gold may be combined with the pyrites and so invisible and perhaps difficult of extraction; and below water level the working places have to be drained by pumping.

Hence the miner finds the deeper ore more troublesome and less profitable, and it has to be worked on a much larger scale than is possible to a party of working miners. The surface ore, moreover, is both absolutely and relatively richer, owing to the processes of surface and secondary enrichment. Surface enrichment is due to the rapid precipitation of gold from a gold-bearing solution when it approaches near the surface of the earth; for its temperature is then quickly reduced, and the oxygen and carbonic acid in the surface waters precipitate all the gold that has escaped deposition in deeper levels.

Secondary Enrichment. — This surface enrichment is aided by secondary enrichment. This process may be illustrated by reference to a quartz vein, in which gold is uniformly distributed. If the surface of the mining field be lowered by denudation, the gold in the top of the lode is dissolved by a solution formed by the action of the rain-water on the iron pyrites in the lode. The gold is carried a stage lower, where the iron sulphate is reduced and the gold and pyrites re-deposited. Hence the new top of the lode contains the metals originally distributed through twice the length. This concentration is repeated again and again, until a rich gold patch, such as the famous Londonderry pocket, may cap a comparatively worthless lode.

The richness of the gold quartz lodes at their outcrop led to the view that gold ores are always shallow, a doctrine which received most authoritative expression from Murchison; and at one period in the history of gold-mining the incoming of the sulphides meant the abandonment of the mine.

Mining Costs.

The deeper refractory ores can, however, now be treated, and the downward limit of mining is determined sometimes by the ending of the ore-shoot, and sometimes by the grade becoming too low to pay the increasing costs of mining. There is no simple universal rule which governs the depth of gold ores. The downward extension of each field must be judged independently, considering its geological structure, and the quantity of its ores.

In many fields the gold ores continue deeper than it is at present possible to follow them profitably. But the range of mining is being steadily enlarged, for though the difficulties increase as mines deepen, the costs may be reduced by working on a larger scale, and with improved machinery. The winding by hand or whim is replaced by a powerful engine; the shaft is enlarged, and instead of being kept vertical, may be inclined so as to keep close to the lode, and thus avoid the cost of long cross cuts through barren rock, and unnecessary underground haulage of the ore. Inclined shafts are used all along the Rand, whereas most American and Australian shafts, like the lodes they work, are vertical. Modern shafts and cheap haulage; machine drills, which in large operations are probably always more economical than hand labour; and the more perfect adjustment in processes of gold extraction have all contributed to the steady reduction of mining costs. The consideration of costs in different fields involves so many uncertain factors that it is not always easy to make fair comparisons. Thus in Victoria, for example, fields with the same conditions of wages and transport, and mining ore of the same hardness from similar country rocks, have costs varying from 33s. 11d. per ton of 2,240 lbs., at the North Woah Hawp Mine, which is doing mainly pocket mining, to 20s. 6d. at the South New Moon at Bendigo; one mine on the Bendigo Goldfield, the Central Ellesmere, from 9,480 tons, yielding 1 1/4th dwt., or 4s. 10d. per ton, did not quite pay its expenses, though a neighbouring mine secured a profit out of a yield of 5s. 4d. per ton.

The range of mining costs may be illustrated by the following examples. In Mysore, the

costs at the Mysore Mine are 32s. 1d. per ton of 2,240 lbs.; on the Rand, the average for 1904 was 30s. 8d. per ton of 2,000 lbs.; in Mexico, the costs of the El Oro Mine are 28s. 3d. per ton of 2,000 lbs.; Western Australia, in spite of its refractory ore and costly water, has costs of 18s. 5d. per ton of 2,000 lbs. at the Ivanhoe Mine, and 16s. at the Great Fingall.

Rhodesia, though hampered by long railways and its costly pioneer development, has creditably low costs; the average of six typical mines is 23s. 11d. per ton of 2,000 lbs., while individual large scale open-cut mines work more cheaply; the costs at the Wanderer Mine, for example, being about 6s. 9d. per ton of 2,000 lbs.

The United States shows such low costs as 10s. 3d. per short ton from the Homestake Mine of South Dakota, and in some of the gold-quartz lodes of California; the cheapest great American mine, the Alaska Treadwell, which crushes partly by the aid of water-power for 6d. a ton, has total costs of 5s. 8d. per ton of 2,000 lbs.

Still more remarkable is the record of the Stewarts United Mine in the Bendigo Goldfield where, according to the official returns of the Victorian Mines Department, a gold-quartz lode was mined, in 1905, at a profit, although the ore, of which 7,104 tons was raised in the year, yielded only 1⅓ dwt., or 5s. 4d. of gold per long ton.

Every mine manager is, or should be, engaged in a never ending struggle with costs. He may win by inventing new processes of ore treatment, or by greater economy in management. But when all has been done in these directions it may still happen that the ore is too low in grade for profitable working. Most men who have visited mining fields must have been grieved by the pathetic position of a mining engineer striving against difficulties which rendered financial success at the time impossible. The only chance in many such cases is in the reduction of the cost of living and of wages, by changes in the general condition of the district. There may, for instance, be two mines containing ore of the same value and bulk: one may be a valuable property; in the other the ore may be worth the price of road metal; for the one mine may be in a locality with good roads and a settled agricultural population, so that transport and food are cheap, and the conditions of life so comfortable that miners will accept comparatively low wages. The other mine may be in uninhabited back country, with costly transport and no local food supply; hence wages must be high to satisfy the cost of living and compensate the miner for the risks of taking employment remote from other fields of industry. In such cases the wisest policy may be to delay the development of the mine until the economic conditions can be altered and there is a chance of working it with success. Its premature development involves the tearing out of the rich ore patches with a precarious chance of profit, and the low grade material must be left unworked, and is, perhaps, wasted for ever.

Gold Mining as an Industry.

The credit of gold mining suffers from a reputation for reckless speculation, but the common view of its unprofitableness is exaggerated. It is sometimes said that the gold in the world costs more to produce than it is worth. In some young fields this statement is true, but it is ridiculous when applied to a State like Victoria, which has yielded £280,000,000 of gold in 56 years. It has been claimed, on the evidence of a census of the failures of gold mining companies, and of those engaged in ordinary industrial and agricultural work, that gold mining has lost a smaller proportion of the money subscribed for it than other industries. This result is intelligible, for gold mining is the one enterprise which has nothing to fear from the state of the market. The product is indestructible; its cost of transport is inappreciable; and there is no fear of a slump in price by over-production. The three great causes of failure in gold mining, are (1) over capitalisation; (2) rule of thumb procedure, leading to the choice of unsuitable methods; and (3) the frequent necessity for distant and therefore often expensive control.

The most sensational failures have been reckless extravagance due to over haste in the development of a field in consequence of a sudden boom. The history of Coolgardie with its wild waste of British capital in hopeless schemes is an example of this type of failure. Of the three causes of failure, the greatest is over-capitalisation, due to extravagant hopes, which are generally based on false analogies. This loss would be lessened if investors would estimate the value of a mining property for themselves, and trust for reward to dividends from the mine and not to profits from the share market. The estimation of the value of a mine involves three factors :—

1. A true appreciation of its geological structure, so that its future may be estimated by the history of a really similar mine.

2. An estimate of its probable life is often speculative, but may be a matter of simple calculation. It is usually necessary to consider separately ore already proved to exist, and that of which the existence is problematical, but which may be reasonably expected to occur, and to be workable at a profit.

3. The cost of extraction, dependent on local economic conditions, the quantity of the ore available, and the readiness with which the gold can be extracted from it.

Gold mining may be organised on two very different systems. It may be developed as a local industry, or as an investment for distant capital. The method which has found most favour in Eastern Australia, for example, is that of local development. A mine is discovered by a prospector, who works it himself or with a party of "mates" until they have exhausted the outcrop, and the depth becomes too great for their simple appliances. Their work, however, has shown the value of the upper part of the lode, and probably determined the position and length of the ore shoot.

A few thousand pounds are raised by local investors and spent in the erection of a small battery and the construction of a shaft. This money, judiciously and economically spent, probably raises sufficient gold to pay for a larger equipment and more extensive development. Thus the mine is made to develop itself. The Mount Morgan Mine, for example, produced its vast output without, according to a recent speech by Sir Horace Tozer, any capital at all; and the Madame Berry Mine won its million and a half of gold with a capital of £15,000. The great advantage of this method is that no great sum of money is risked, while the future of the mine is uncertain; and there is no insatiable drain upon the profits of the mine to pay the interest on a huge capital. The drawbacks are that such mines are often begun by men of limited experience, who may be baffled when they meet new conditions; and if the mine strikes a zone of barren ground, it has no reserve fund with which to prospect for better ore, and has to make calls upon the shareholders. There is no strong economic objection to the system of calls, which merely assumes that shareholders are capable of investing their capital more judiciously themselves than a mining company can do it for them. It often happens, however, that such calls give a mine a bad name. The shareholders are discouraged, they refuse to subscribe, and the mine may be abandoned, when further prospecting would have given it a new lease of life.

The antithesis of this method of gold mining is that which has been found necessary in South Africa. The prospector finds some indications of a mine, pegs out a claim, and sells it to a syndicate. The syndicate founds a Developing Company to develop the mine. The Developing Company may build a branch railway to the locality, erect the necessary plant, sink shafts, drive levels, and prove the mine by elaborate and costly sampling. Years later, the Developing Company founds a Mining Company to mine the property thus opened up. All this time the capital has been growing steadily, and the mine starts work with a handicap, which, though a good property, it cannot bear. There are mines in South Africa, with only a five or ten stamp mill, which have to pay the interest on a capital of £100,000 or £200,000 before they begin to make a profit, and repay the money that has been spent on them. A ten stamp battery, unless supplemented by other grinding appliances, cannot be expected to crush more than 15,000 tons a year. If the mine have a capital of £150,000, it has an interest charge, at 5 per cent., of £7,500 a year, and must earn a profit of 10s. per ton of ore crushed to pay the interest alone. Only the profit earned in excess of this very creditable amount is available to refund the capital.

Both systems of mining have their critics and advocates. The East Australian method is especially condemned for the comparatively crude sampling which is possible with it. But both methods have their uses, and are right if applied where they suit the local opportunities. The present great output of gold is due to the adaptation of mining methods to the different needs of widely-scattered fields; and the industry as a whole is well-managed, in spite of the gambling in shares, which is parasitic on it. Its success is indispensable to modern industrial prosperity, and it has had a deep influence on economic theories. Thus, in Bryan's opening speech in the present electoral campaign in the United States, he explained that he had abandoned bimetallism, as that system was no longer advisable, owing to the unexpected increase in the world's gold supply. The great existing gold output may be regarded with the more satisfaction, as the success of one country is not gained at the expense of the rest. There is no underselling, and the pro-

gress of one mining field usually adds to the prosperity of others. All the chief mining countries have contributed to the methods of modern gold mining. Germany invented the stamp battery, which owes its present high efficiency to America. Percy, of London, gave us chlorination, and J. S. MacArthur, of Glasgow, the cyanide process. California devised hydraulic sluicing, and New Zealand the gold dredge; while Australia, besides leading the way in deep gold-quartz mining, developed the modern system of fine-crushing and filter-pressing. Every important advance helps gold miners throughout the world, for, to the honour of the industry, there is no attempt to keep gold mining processes as jealous secrets. Gold miners of all nations recognise that they are colleagues and not competitors, and share their successes together as an international, industrial brotherhood.

DIAMOND CUTTING IN AMSTERDAM.

Among the many industries of Amsterdam that of diamond cutting has long been an important one. Since the fifteenth century it has been extensively carried on, and at the present time no fewer than sixty firms are registered in Amsterdam as diamond cutting or diamond polishing companies. Some of the firms restrict themselves entirely to one process, that of diamond polishing, while others carry out the whole of the three processes — diamond splitting, diamond cutting, and diamond polishing. According to the American Consul at Amsterdam, in one of these typical complete factories 90 per cent. of all the many thousands of rough uncut diamonds received every year come from South Africa and those principally from Kimberley. It gives some idea of the importance of this industry in Amsterdam to realize that 400,000 diamonds were cut and polished in this factory in one year alone, and that 300 to 500 men are daily employed in the different workshops by this one company, which also employs about twenty women, who are entrusted with the very important work of diamond cutting. Although the firm was established in 1843, it was not until 1875 that women were employed in the factory, but so satisfactory was the experiment that now nearly the entire work of diamond cutting is done by them, thousands of diamonds passing annually through their hands.

The first of the three processes through which the rough, uncut diamond has to pass is that of splitting the stone. About twelve men are employed in this task, which is all done by hand without the aid of machinery. It is not a lengthy process unless the stone contains a great many flaws, for an ordinary diamond weighing about 10 carats can generally be split in fifteen minutes. The object is to divide the rough, uncut diamond (containing flaws) into several pure, flawless stones, and in order to do this strong pressure is exerted on the weak spots (caused by flaws) by means of a diamond-tipped tool, which is held in the right hand. It is an old and well recognised principle that "nothing but a diamond will cut a diamond." In the left hand is held a curiously shaped little frame into which the rough diamond now to be split has been firmly fixed. Great pressure is then used on the weak spot, and in a few moments the diamond splits into two portions. Should there be any more flaws in either of these sections the process is repeated until several pure flawless diamonds lie on the rough wooden tables of the workmen, ready now for the second process, that of cutting. This process, like the first, is almost entirely performed by hand in the factory referred to, but with one striking difference—the work is done by women and girls instead of men. Only in the case of very hard difficult stones is machinery necessary, and then men are employed to use it. The work of diamond cutting is a delicate and difficult task, very trying to the eyes too, for some of the diamonds are so minute that 400 of them or more may weigh only half a carat. Each worker is responsible for the packet of diamonds she receives at intervals from the forewoman, and if by accident she loses one of the precious stones she has either to find it again or refund its value. The tools employed in diamond cutting are very similar in appearance to those used in the first process, that of diamond splitting. In both cases diamonds are used as knives after having been firmly fixed into the tip of pear-shaped tools. The women hold in the left hand the rough diamond they wish to cut, which has also been firmly fixed into a wooden frame. Little jets of gas are always kept burning on the various tables ready to be used at any moment when melted wax is necessary. The only real difference in the two processes of diamond splitting and diamond cutting lies in the fact that whereas the men who split the diamonds use pressure on one spot only (where the flaw occurs) the women devote themselves to rounding the whole stone, and carefully cutting off all angles to be seen on its surface by means of the sharp diamonds they hold in their right hands. Occasionally they have very large diamonds to cut, which take a great deal of time, but an ordinary stone weighing about 10 carats would not take so very long. When the diamond has been sufficiently cut and rounded, it is then ready for the third and last process, that of polishing. This work requires a great deal of time and skill, and is performed entirely by machinery, a steam-engine supplying the motive power for all the iron discs. The process consists in giving to the rounded diamonds what is termed, in technical language, their necessary "sides." All diamonds are divided into two classes, "brilliants" and "roses," although the only real difference between them lies in the number of "sides" they individually possess after having been polished in one of the many diamond factories. A

"brilliant" must possess fifty-eight "sides" (a few years ago the lowest number was sixty-four, for there are fashions in diamond cutting), but a rose need only possess twenty-four "sides." Another (though slight) difference between them is, that a brilliant is pointed at both ends, while a "rose" diamond has one end flattened and the other pointed. When the diamond is ready to be polished it has first to be soldered into a pear-shaped frame made of zinc and then dipped into a preparation of oil and diamond dust before being fastened, with three others, into a strong frame placed in close proximity to an iron wheel. This little disc is then set in motion, by connecting it with the great engine, and the wheel immediately turns at the rate of 2,000 revolutions to the minute. As it revolves, the four diamonds set in the adjacent frame are gradually polished by means of the friction produced on their surface by the particles of diamond dust still adhering to the oil into which they had been previously dipped. Only one portion of a diamond can be polished at once, and consequently, when this part has been dealt with, the stone has to be re-soldered, so that another portion of its surface may be subjected to the friction of the wheel. The process of re-soldering takes place about twenty times in the case of every brilliant, before it can be considered to be thoroughly polished, and to have acquired all the necessary fifty-eight "sides." The "rose" diamond, with its smaller complement of twenty-four "sides," needs to be re-soldered only about six times.

During the last year the press, both in South Africa and Europe, has devoted considerable attention to the discussion of projects having in view the establishment of a diamond polishing industry in Cape Town, Johannesburg, and other places, but such projects are not regarded seriously in Amsterdam. Wages paid in the diamond industry at Amsterdam are estimated to have amounted to £1,700,000 in 1905.

INLAND REVENUE.

The figures given in the fiftieth report of the Commissioners of Inland Revenue, just issued, lend some support to the contention that temperance is making headway, and that the diminution in the consumption of beer and spirits which has been so noticeable in recent years is not, as it is sometimes said to be, due only to hard times. Industrial conditions have been good for some time past, and if increase or decrease in the consumption of alcohol depended only upon good wages the figures in the present report would show expansion in the beer and spirits consumed *per capita*. The number of proof gallons of colonial and foreign spirits imported into the United Kingdom in 1906-7 was less than in the preceding year—8,129,503 gallons as against 8,228,435; the quantity of home made spirits retained for consumption was less *per capita* in 1906-7 than in 1905-6—·74 as against ·75; the quantity of beer retained for consumption in 1906-7 was 27·81 gallons as against 27·90 in the previous year, and 30·49 in 1896-7. The decline in 1906-7 was smaller than in previous years, but there was a decline.

Some interesting particulars are given as to the Income-tax. The net yield of the tax for the year 1906-7 was £31,891,949, an increase of £597,197 compared with the previous year. The certified gross income of the 379,456 payees was £107,022,457, and of these 21 paid on incomes exceeding £50,000. Profits from British, Indian, Colonial, and Foreign Government securities show an increase of £8,428,000, or 21·9 per cent. over the decennial period 1896 97—1905-6. The assessments on the incomes from British Government securities in 1905-06 was £15,993,607, as against £13,641,207 ten years earlier. The assessment on those from Colonial Government securities comes next, and amounts to £13,906,601, then India £8,862,807. These last figures show little increase upon those of 1896-97, which were £8,065,866, and the African assessment is considerably less now than it was ten years ago—£541,896 as against £727,826. £30,932,067 represents the total income derived from Indian, Colonial, and foreign Government securities in 1905-6, but the total of *all* income from abroad that could be identified in the statistics of the income tax was £73,899,265 against £66,062,109 in 1904-5. Businesses, Concerns, Professions, &c., show an increase of £131,566,000, or 34·8 per cent. during the ten years. On a more particular comparison, railways in the United Kingdom show for the same period an increase of £3,700,000; mines, £9,491,000; gas works, £1,884,000; water works, £1,801,000. It is very noticeable that salaries of Government, corporation, and public company officials increased in the ten years from £56,449,000 to £93,186,000, or 65 per cent.

The extent of the fall of rents of agricultural land, and the absorption of land in the neighbourhood of large towns for building purposes, is shown in the figures under "Lands," which show a decrease of £2,649,359, or 4·8 per cent. The principal decreases were in Kent (outside the metropolis), amounting to 11·1 per cent.; Essex, 13·5 per cent.; Suffolk, 13·7 per cent.; Norfolk, 10·1 per cent.; Somersetshire, 8·5 per cent. On the other hand, "Houses" show an increase of £46,711,940, or 29·4 per cent. in the ten years accounted for by the erection of new buildings and increased rentals of old ones. The increase was distributed among the three countries as follows:—England, £41,482,930; Scotland, £4,476,342; Ireland, £752,665. The increases mainly occur in the Metropolis, 17·2 per cent.; Surrey (outside Metropolis), 57·5 per cent.; Middlesex (outside Metropolis), 75·5 per cent.; Essex, 74·6 per cent.; Northumberland, 48·4 per cent.; Durham, 42·6 per cent.; Kent (outside Metropolis), 42·3 per cent. The prosperity of the country generally is indicated by the figures

relating to profits from businesses, concerns, professions, employment (except those of a public nature, and certain interest). The gross amount of income under this head brought under review of the Department for the year 1905-6 was £508,664,345, being an increase of £131,565,580, or 34·8 per cent. over the amount of 1896-7, and of £4,096,546 over that of 1904-5, or ·8 per cent. The increase was distributed among the three countries as follows:—England, ·9 per cent.; Scotland, 1·0 per cent.; Ireland, 2·7 per cent.

AGRICULTURAL CO-OPERATION IN GREAT BRITAIN.*

The problems to be solved are the limitation of the rural exodus and the rehabilitation of rural life.

The economic aspect of the problem is how to make farming pay on a small as well as on a large scale. The economic forces at work against the farmer are the competition of new countries, made possible by the development of cheap transport, and the competition of older countries in which an agricultural revival has taken place. In the latter case, co-operation has been one of the chief factors in the success of our competitors. By its means farmers are enabled to obtain goods of guaranteed quality and purity; to purchase their requirements more cheaply, and so to decrease the cost of production; to bulk the consignment of goods purchased and goods sold, and so to reduce the cost of transport; to get into closer touch with the consumer, and so to secure a larger share of the profit upon goods sold; to place large quantities of produce of uniform quality upon the market, and so to meet the requirements of a wider circle of customers and to obtain better prices.

Co-operation has other advantages which should commend it to us. Among them are the development of character and of the intellect. Farmers as a class are intensely conservative, wedded to the ways of their forbears and jealous and mistrustful of one another. Intercourse at the meetings of their societies tends to break down the barriers of mistrust and jealousy which separate farmer from farmer, to broaden their outlook, and to teach them no longer to regard the welfare of their neighbours as detrimental to their own; while the discussions upon business matters have a stimulating effect upon their minds, and arouse a spirit of inquiry and a desire for knowledge.

While there are instances of agricultural co-operation in Great Britain of many years' standing, there was no systematic effort to promote it until the Agricultural Organisation Society was formed in 1901. It is true that co-operation was part of the programme of the National Agricultural Union, of which Lord Winchilsea was the founder and the inspiring spirit, but it was never seriously taken in hand. In 1900, in addition to the National Agricultural Union, another body had come into existence to promote agricultural co-operation, viz., the British Agricultural Organisation Society. This was done, and the results obtained have been eminently satisfactory.

The number of agricultural co-operative societies affiliated to the Agricultural Organisation Society had reached 153 at the end of June, 1907. These included 109 societies for the purchase of requirements and sale of produce, 14 dairy societies, 13 credit societies, 4 allotment societies, 2 motor-service societies, 2 fruit-grading societies, 7 miscellaneous societies, and 2 federations.

The membership of the societies in June, 1907, was roughly estimated to be 10,000, and their turnover in 1907 is expected to reach £450,000.

The material benefits to the members of the societies have been considerable, but it is impossible to estimate them with any accuracy. In the purchase of requirements they have secured reductions in price averaging probably about 15 per cent., and the benefit of obtaining goods of guaranteed purity is fully equal, if not superior, to that of the reduction in price. The sale of produce has not been developed to the same extent as the purchase of requirements, but where it has been carried out the net prices to the farmers have been substantially increased.

There has been ample evidence of educational as well as material results. It is the experience of the societies that co-operation has produced a more neighbourly feeling amongst the farmers, who become more ready to interchange ideas and place their knowledge at each other's disposal. With this has come a greater desire for knowledge.

An important form of co-operation is co-operative credit. Village banks on the Raiffeisen model were promoted by the Co-operative Banks Association before the formation of the Agricultural Organisation Society. In 1903 the two associations were amalgamated. In June, 1907, there were thirteen village banks affiliated to the Agricultural Organisation Society. The object of these little banks is to provide their members with capital for reproductive purposes at low rates of interest. A Central Co-operative Agricultural Bank has been formed for the purpose of financing the village banks.

For the success of the small holdings system co-operation is essential. Without it the small holder is at the mercy of the middlemen from whom he purchases his requirements and to whom he sells his produce. Co-operation places the small holder on an equal footing with the large farmer in his dealings, and provides him with the use of cheap loans for economic and productive purposes.

The intense conservatism of the farmer makes the work of organisation very difficult. His naturally suspicious temperament adds to the difficulty, as he is apt to imagine that those who are urging him to co-operate have an axe to grind in doing so. Gradually the Agricultural Organisation Society has been able to remove this suspicion from the farmers' minds, and

* Paper read by Mr. R. A. Yerburgh before Section F of the British Association, at Leicester.

the success of the co-operative societies is breaking down their disinclination to adopt new methods.

The chief difficulty which now confronts the agricultural co-operative movement is that of obtaining the necessary funds for carrying on propagandist work. The Agricultural Organisation Society feels that it may reasonably look to the Government for assistance. The Small Holdings Committee recommended that the society should receive a grant from the Board of Agriculture, and in the Small Holdings and Allotments Bill the importance of agricultural co-operation in the development of small holdings is recognised. In Ireland the Department of Agriculture makes a grant to the Irish Agricultural Organisation Society proportionate to the subscriptions which it receives from other sources, and it would greatly help to foster the movement in Great Britain if the Board of Agriculture would make a similar grant to the Agricultural Organisation Society.

NEW DOCK AT SOUTHAMPTON.

The new dock about to be constructed at Southampton will be the deepest open dock in the world. Exclusive of the quays and cargo sheds the dock will cover an area of sixteen acres, lying between the Empress Dock and the Trafalgar Graving Dock. The water area will form a parallelogram 1,700 feet by 400 feet. The depth of the new dock will be eventually dredged out to a minimum depth of 40 feet, increasing to 53 feet at high water. There will be berths inside the dock for four vessels each about 800 feet long, and these will, of course, be able to enter and leave at any state of the tide. Outside, the deep-water quays in the Test already furnish a depth of 32 feet at lower water, but the new dock is designed to give more than this, in fact greater depth will there be secured than is obtainable anywhere else. No ship in existence requires so great a depth of water as 40 feet, but it is notorious that the size of vessels is increasing so fast that a margin for future development is absolutely necessary. The new dock opens into the Test, where four new quays are to be constructed, two of about 700 feet in length and two of 500 feet. Southampton possesses very exceptional advantages as a port owing, first, to its sheltered position, and, next, to double tides, which not only extend the normal period of high water to four hours, but also restrict the ordinary range of spring tides to 13 feet, and in addition render unnecessary the provision of locks. Since 1843, the date of opening the first dock, both wet and dry docks have been added, and the acquisition of the port by the London and South-Western Railway Company, in 1892, has led to still greater developments. The Prince of Wales Graving Dock, opened by the King in 1895, and the Trafalgar Graving Dock, constructed since that date, and brought into use quite recently, are 750 feet and 875 feet long respectively. Other improvements, too numerous to mention here, have been carried out by the company, and the new dock, the site for which has already been cleared, will not only bring the existing accommodation up to date, but enable Southampton to enter into serious competition with the port of London, whose circumstances have suffered owing to the long delay in carrying out even a part of the recommendations of the Royal Commission of 1900-1902.

OUR FOOD SUPPLIES.

The report of the Board of Agriculture and Fisheries upon agricultural imports contains some striking figures with regard to the growing dependence of the population of this country upon foreign supplies of food. Taking the last 25 years the total imports have increased from 444,000 tons to 1,078,000 tons. While our foreign supplies have increased from 415,000 tons to 838,000 tons, the Colonial supplies have gone up from 29,000 tons to 240,000 tons. Or, to put it in another way, Colonial supplies have risen from 6 per cent. to 22 per cent. Of the total imports the greatest relative increase is in the imports of dead meat, of which we consume twice as much per head as we did 20 years ago. In 1886 the proportion per head of fresh beef, mutton, and pork was 4·8 lbs., last year 25·9 lbs. All other descriptions of dead meat showed increase, and if the total is taken, it has increased from 20·7 in 1886 to 47·3 in 1906. The consumption of imported bread stuffs has increased in a much less degree notwithstanding the reduction of home supplies. The total home crop has decreased from about 1,850,000 to 1,350,000 tons, yet we find that the proportional quantities consumed per head of the population of corn grain, meal, and flour imported, which in 1886 was 59 lbs., in 1906 was only 62 lbs. although in 1894 it had risen to 117 lbs. Taking these figures in conjunction with those given above relating to meat, the conclusion seems to be that the proportion of meat to bread in the dietary has substantially increased, or in other words that the average standard of living has risen during this period. The figures in relation to butter and margarine appear to support this contention. The proportion per head of the population of butter and margarine used has risen from 7·5 in 1886 to 13·9 in 1906. So with eggs, which have risen from 29 per head of the population in the earlier year to 52 last year. It is only cheese which shows comparatively little expansion, as from 5·4 lbs. per head 20 years ago to 6·8 last year. Having regard to the ever-growing demand for milk in the United Kingdom, and the fact that only a quite insignificant quantity is imported, it is pretty safe to say that the quantity of home cheese sold is not to any appreciable extent larger, notwithstanding the increase of stock, than it was 20 years ago, so that we must assume that less cheese is being eaten, meat apparently having taken its place. If that be so, we have a further indication of the growing prosperity of the country.

There has been a remarkable increase in the imports of Colonial butter. In 1886 the imports from all countries amounted to 78,800 tons; last year they had increased to 212,100 tons; but whilst foreign imports had increased from 76,950 tons to 159,300 tons, the Colonial supplies increased from 1,850 tons only to 52,800 tons. Imports of butter from the Colonies, which barely exceeded 2½ per cent. of the total in 1886-8, had reached 25 per cent. in 1904-6. From the details given in Table CI, it would seem that the supplies from Denmark, France, Holland, Norway and Sweden have reached their maximum. Those from France, Sweden, and Denmark were considerably smaller in 1906 than in 1902. On the other hand, the imports from Russia increased from 490,091 cwts. to 605,549 cwts., and from the United States of America from 54,458 to 157,312 cwts. Amongst the Colonies, the increase of the Australian import is the most noticeable. In 1902 it was only 89,397 cwts., in 1906 it had risen to 561,114 cwts., the increase being principally from New South Wales and Victoria. On the other hand, the imports from Canada fell from 285,765 cwts. to 190,968 cwts. It should have been said that the imports from New Zealand increased from 157,993 to 311,672 cwts.

Over 2¼ thousand million (2,264,887,000) eggs were imported in 1906, being rather more than in 1905, but less than in any of the years 1902-3-4. Russia sends more than one-third of the total, Denmark, Germany, Belgium, and France appearing as the other chief contributors. The stationary character of these imports would seem to indicate that poultry farming is on the increase in the United Kingdom. The appearance of Australia among our sources of supply for eggs is a noteworthy feature, Victoria sending 220,000 and South Australia 728,000 last year. Canada, which has entered this trade in recent years, does not seem to be maintaining her footing, the number sent in 1906 being less than half that received in 1902 or 1903. Apart from bananas, which, being recorded in bunches, cannot enter into comparison, oranges represent nearly half of our total supply of fruit from abroad. Apples, however, stand a good second, of which almost exactly half came from the United States, and about one-third from Canada. Australia sent 157,000 cwt., largely from Tasmania, while Portugal sent nearly as much (168,000 cwt.) as all other European countries put together. Spain and Portugal account for 95 per cent. of the grapes received, the Channel Islands, with 16,000 cwt., being the principal contributor to the remainder. More than half of the pears received come from France, and four-fifths of the cherries.

BELGIAN TECHNICAL SCHOOLS.

The prosperity of Belgium, which is advancing rapidly from year to year, is undoubtedly due to the technical teaching which is prominent in the diversity and numbers of its institutions. These schools, created and maintained by the Government, are under the general supervision of the Department of Commerce and Labour, which appoints a Board of General Supervisors, whose duty it is to see that the teaching is of a high standard, as well as to look into the sanitary and hygienic arrangements of the various schools. Belgium enjoys the distinction of being the first country to organise domestic training schools, the first being established in 1889. According to the American Consul at Liège, this system comprises in its practical curriculum maintenance and cleanliness of dwellings, furnishings, laundry work, cutting, fitting, making, and repairing ordinary garments, cooking, and, in the rural districts, gardening, dairy work, and the care of poultry. The theoretical teaching consists of lectures on hygiene, domestic economy, care of children, and sick nursing. This particular training is intended for the children of the working classes, the object being to prepare the pupils for the economical management of a house, as a mistress or as a servant. In the more advanced schools, termed professional domestic schools, the theoretical and practical teaching are equal, and includes designing, cutting, dressmaking, millinery, artificial flower making, lace making, embroidery, china painting, commercial book-keeping, typewriting, domestic economy, &c. The practical effect of this system not only enables a girl to gain a livelihood by the application of her knowledge in the various branches taught, but is particularly emphasised in housekeeping. While the Government has legislated against the employment of women underground, they assume important places in the large manufactories, and work side by side with the male *employés*, showing equal ability. Many of the large workshops give technical lectures and demonstrations expressly for the female employee who is unable to take advantage of the technical course offered to boys. In training boys for professional and industrial work, attention is given to the demands of the various localities. The various schools are as follows:—Mechanical and electrical engineering, iron and steel, wood cutting, carpentering, joining, plumbing, watch making, jewellery making, firearm manufacturing, book-binding and gilding, painting, designing, engraving, spinning and weaving, dyeing, tanning, basket and lace making, upholstery, tailoring, telegraphy, music, &c. While the practical work of these institutions is the same as in the actual workshops, the theoretical training is intended to meet what the workshop does not supply. Apart from the Government technical training schools, private institutions have been established, and are partly maintained by private subscriptions. These, however, look for help to the Government. Liège, since the fourteenth century, has been universally known for the manufacture of firearms. It has kept pace with the various evolutions in this industry. The well-known School of Arms in Liège turns into the local workshops annually, young men already fitted to apply them-

selves practically to any branch of the firearm trade. One of the practical requirements before graduation is that the pupil must not only be able to make any of the various parts of a gun, but must be able to put these parts together with facility. In theory and practice they are as perfect as age will permit, and yet they must enter the factory in the capacity of an apprentice and await the recognition of the foreman. The system of education forms a capability that is sought for by many countries, and the workman after leaving the school of arms can readily find work either at home or abroad. Many practical gunsmiths have attached to their homes a small workshop where during their spare hours they work under the piecework system, and are, therefore, enabled to earn more money. This class of labour is always in demand, and at no time need the firearm workman be out of employment. The School of Textiles is an institution where teaching has brought out the manufacture of cloth and all branches attached to that industry to a high state of perfection. Year after year the cloth manufacturers in other countries apply to this school for a competent man to serve them as foreman or superintendent. In Belgium itself the pupils at this institution are immediately taken up by the local manufecturers and their future is assured. The Government, to encourage application, gives yearly a money prize to pupils having distinguished themselves at the school, this being intended to meet the expenses of a journey abroad. The same conditions prevail at the School of Mining, and all the other schools. Technical education in Belgium has for its object to assist the employer and employed alike. The present condition of both is highly satisfactory, and the future points to a substantial advancement. The country is tranquil, the working classes are increasing their savings annually, a spirit of contentment is everywhere manifest, which condition of affairs guarantees uninterrupted labour. Lockouts and strikes are rare, while the question of the unemployed is absent. All workmen are more or less skilled, and their labour wins a compensation satisfactory to them. The continued industrial and commercial advancement of Belgium stimulates the demand for labour, and the labour, owing to technical education in all its branches, readily meets these demands.

CALCIUM: ITS PROPERTIES AND POSSIBILITIES.*

General Properties.—Calcium is a silvery white metal readily oxidised in moist air. It is very light (sp. gr. 1·52), fairly malleable, has a high specific heat, and is a good conductor of electricity. It is about as hard as aluminium, but at 400° C. becomes as soft as lead. It is volatile, and can be sublimed *in vacuo* between 700° C. and 800° C., and melts at the latter temperature. It is a very powerful reducing agent.

Calcium Alloys.—The chief effects of alloying calcium with other metals are to produce brittleness, crystallisation, and hardness; to promote oxidation and disintegration on exposure to air; to confer the power of decomposing water and in other ways increasing the chemical activity.

The author's experiments confirm Roberts-Austen's observation that the presence of small amounts of metals of high atomic volume will cause deterioration of the physical properties of metals of low atomic volume. The atomic volume of calcium is high (25·4), and the effect of small amounts on other metals is decidedly prejudicial, provided that the metals in question are pure. The experiments were conducted in a converse manner to Roberts-Austen's, *i.e.*, the constant was a metal of high atomic volume (calcium) instead of being low (gold). In the course of the work the following observations were made. When an alloy is made of calcium and some metal which possesses a chemical property in common with it, an increased activity in the manifestation of that property is noticed in the alloy. This increase appears to be greater than would be obtained by the simple admixture of a more active metal, the presence of calcium usually increasing the activity of the other metal. In some cases the alloy is more active than either of its constituents.

Further, the chemical properties of calcium appear to be more pronounced in an alloy with a metal having an atomic value closely approaching that of calcium than they are in an alloy of the same percentage with a metal having a much lower atomic value. The two metals in question should be about equally active when unalloyed in the particular property with respect to which they are to be compared. It is probable that both these principles are general, and not confined to calcium, although more extended research on these lines would be desirable.

Industrial Possibilities. — The most promising applications of calcium are as a reducing agent and for the refining of metals. In the latter case it acts in three distinct ways:—(1) By reducing oxides and sulphides; (2) by eliminating dissolved gases; (3) by forming compounds with certain impurities, thus rendering them less deleterious. All three modes of action are strikingly shown in the case of copper. A suitable addition of calcium will remedy "dry" or "sulphury" copper, give a sound casting, and give a soft and tough ingot with prohibitive proportions of bismuth or antimony, besides restoring ordinary overpoled copper to tough pitch. If excess of calcium is present, however, it induces brittleness on its own account. With one or two doubtful exceptions, no alloy of calcium has shown any promise of commercial utility so far as physical properties are concerned, its only likely application in this direction being its hardening property.

* Abstract of a paper read by Arthur E. Pratt, B.Sc., A.R.S.M., read before Section B of the British Association, at Leicester.

ARTS AND CRAFTS.

Pottery and Porcelain.—The pottery and porcelain trades perhaps more than any others have made great strides in recent years. The advances in chemical science have rendered many things comparatively simple which in days gone by would have been difficult, if not impossible. Old-established factories famed for productions in one exclusive style have been trying new experiments and doing work quite unlike what we should, from their traditions, naturally expect from them. And this has been the case not merely in England but all over the continent. At the time of the last Paris Exhibition in 1900 it seemed as though nearly all the makers in Europe were working on more or less the same lines. Crystalline glazes were the order of the day, and everyone was producing them more or less successfully. There were differences, of course, between the crystalline glazes of, say, Sèvres and Copenhagen, but they were not such as to strike the quite untrained observer, and the effort was all in the same direction. Now that the exhibition is a thing of the past, and that there is no enormous international exhibition looming in the immediate future, the different factories are, if not exactly returning to their old paths, at any rate working more on their own special lines.

Sweden.—The two big works in Sweden, Rörstrand and Gustafsberg, appear to have practically given up making crystalline glazes. In the case of Rörstrand at least this is to be regretted, as some of their efforts in this direction and in *sang de bœuf* were really very successful. A good deal of the work being done at this factory to-day is not unlike what we are accustomed to associate with Copenhagen. It is pale in colour and delicately painted for the most part, but the distinguishing feature of the Swedish pots is the use of modelling. The neck of the vase is very often adorned with, or even formed of, delicately modelled flowers or leaves. The forms are generally very happy, especially when, as frequently happens, the back side of the leaf is represented, slightly bent over so as to make a decorative feature of the mid-rib. A recent achievement at the same works, of which the inventors are naturally proud, is the production of a fine glaze which is practically black in colour. They are only beginning to use it, but it promises to lend itself to decidedly novel effects.

Gustafsberg has been developing almost exclusively the kind of work which can be produced at a fairly low price. They are no longer making imitations of Wedgwood, but are proceeding according to modern Swedish taste, and some of their very cheap dinner services, &c., are exceedingly tasteful. In their ornamental ware they are making good use of the practice of coating the vessel with slip and then scratching out the ground. They are also turning out a good deal of heavy-looking stoneware decorated with various colours.

By the way, it is interesting to note that in both these factories the artist in chief is a man who did not begin life as a designer for pottery, nor, indeed, as a designer at all, but as a purely pictorial painter, which accounts for some of their failures as well as for their successes.

Copenhagen.—At Copenhagen, the Royal Porcelain Works have been pursuing the even tenor of their way. They are still making experiments in crystalline and other glazes and steadily progressing in this direction; but the bulk of their work is naturally, as it has been for so long, painted and modelled porcelain. They are constantly adding to their menagerie astonishingly life-like animals, which have the additional merit of showing to great advantage the perfection of the material in which they are executed. The greater part of the work, of course, is in the pale colours with which we are familiar, but they have produced also vases in more brilliant blue and in a rich green. A new departure of theirs is a series of figures in old Danish costumes, brightly painted in on-glaze colours. Something of the kind was done in the factory years ago, but these figures are entirely modern in feeling.

The Royal Works have made their reputation for a particular kind of work, and they very naturally produce what is expected of them, but the case is very different with the more recently established "Aluminia" earthenware factory, which is under the same direction. These works have only been established about four or five years, and they are already doing very good work. The most characteristic vases are painted in deep rich blue and green on a creamy body. They do use other colours, notably yellow and red, but it is the blue and green which are most generally employed, and, on the whole, most satisfactorily. The painting is large in scale and in a sense, rather coarse, as befits the coarse material used and the large size of the objects made; but one has only to put a piece of Aluminia *faïence* side by side with a piece of real or affected "peasant" pottery to see that the painting is quite accomplished and that the design has received an amount of consideration and a care which we look for in vain in the more primitive work. Until lately the factory had confined its energies to the production of pots, vases, and dinner services, but a short time ago they began making tiles. Their first piece of work of this kind was for the decoration over the doorway of the Tropical Bird House in the Copenhagen Zoological Gardens—and a very satisfactory piece of work it is. The design consists of peacocks and other birds surrounded by a certain amount of green foliage—and the whole thing, which is mainly in blues and greens with only a few patches of other tints, makes a fine bit of colour. It is interesting to note, by the way, that these are 4-inch tiles—a size which seems very popular just now in Northern Europe.

Amongst the mass of work being turned out by the various factories in Denmark, it is interesting to see the rather accidental looking lustre pieces by

Hermann Kähler—who seems to be still working very much on the lines he indicated at Paris in 1900.

Delft.—Delft ware we are apt to look upon as being practically confined to vases, plates, plaques and tiles painted in blue, or perhaps brown or manganese on a white ground—and, of course an enormous trade is done in such things, but the energies of Messrs. Joost Thooft and Labouchère are covering a very much larger field. The panel in *opus sectile* at the Paris Exhibition was the beginning of what is now quite an important branch of their work. The material, which is primarily intended for outside decoration, is made in a good range of low toned, rather earthy colours, the pieces are cut out of the wet clay, and the painting, where painting is necessary, is done in slip. If we miss a brightness of colour in the finished work, that is somewhat made up for by the absence of the shiny quality of glaze—never very pleasant in wall decoration—and by the feeling that there is no danger of the material crazing or playing tricks after long exposure to the air. The designs executed by this method are many of them very elaborate, and include figure subjects—and the fact that the pieces, cut before firing, join together with only a very narrow cement outline, proves that the makers have their material well under control.

This *opus sectile* is the biggest departure from the old methods of work which is being made at the present time—but, of course, for some years past crystalline and dull lustre tiles, some of them very beautiful in quality, have been made at Delft—and the raised outline process is used to good purpose, sometimes with a sort of encloisoned jewel effect which is quite fascinating.

As regards vases, an effort has been made to revive the old Delft ware painted on the unbaked tin enamel, but it seems that the demand is all for the more pictorial painting on a white body. Some vases have lately been made of a sort of cream parian body, decorated with patterns in green and gold. The green, which is only used in fairly small touches, is of the same consistency as the body, and the gold is put into the incised lines which give the outline of the pattern. The effect is very fresh both in colour and design.

In view of our somewhat feverish haste in this country to supply craft teaching at all costs for all kinds of work, and to assume that the school of art, or the craft school, is, under existing modern conditions, the proper place in which workers in the more artistic crafts are to get their training, it is rather interesting to note how little agreement there is on this point in some of the big European pottery works. At one place we are told that all the paintresses come direct from the local school of art to the factory, after passing a competitive examination. At another equally large and progressive factory the painters are taken into the works as soon as they leave the elementary school, with no art school training at all, and receive the artistic training necessary for their work in the factory itself. In both cases the work turned out is excellent in quality, and the result would seem to prove that there is not one universal solution of the problem of art education for trade workers.

OBITUARY.

ALFRED BACHE, M.I.M.E., M.I.C.E.—Mr. Bache, late Secretary of the Institution of Mechanical Engineers, died at Penzance on the 6th inst. Mr. Bache, who was born at Birmingham in 1835, was the son of a dissenting minister. He was educated at the Edgbaston Proprietary School and the Queen's College, Birmingham, and graduated at the London University in 1854. He became assistant to the secretary of the Institution of Mechanical Engineers, and in 1884 was elected secretary. He continued to hold this post until 1898, when he resigned on account of ill-health and went to live at Penzance, Mr. Bache was an accomplished musician and a linguist with a knowledge of the Greek, Latin, French, German, Italian, Swedish, and Norse languages. He was elected a member of the Society of Arts in 1887.

GENERAL NOTES.

BRAZILIAN DIAMONDS.—In his report on the trade of Bahia (Cd. 3283-162), Mr. Consul O'Sullivan-Beare refers to the diamonds found in many districts throughout the State of Bahia. The white diamonds of this district have long been celebrated for their matchless colour and fire. The finest stones are characterised by the existence of a slightly bluish tint, which is found in no other stones, and which places the Bahia diamonds apart from and above all others. In former days, diamond mining was a very important interest in Bahia, but the development of the Kimberley Mines had the effect of stifling the industry in Bahia. At the present time there is no systematic mining for diamonds carried on there, the industry being wholly in the hands of the individual "Garimperios" (washers), who work in a most primitive and haphazard fashion, each man for himself. It is only in Bahia the very valuable carbonatos, or so-called black diamonds, are found. These stones owe their commercial value to their intense hardness, and are used as tips for rock drills. Being very rare they are considered more valuable weight for weight than diamonds of pure water. They are found usually associated with diamonds, but strictly speaking they are not diamonds but a distinct variety or amorphous carbon. Most of the diamonds and carbonatos exported from Bahia are smuggled out of the country in order to avoid the 5 per cent. export duty, suc smuggling being a very easy accomplishment owing to the small bulk occupied by the stones.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

CANTOR LECTURES.

Mr. F. HAMILTON JACKSON'S Cantor Lectures on "Romanesque Ornament" have been reprinted from the *Journal*, and the pamphlet (price one shilling) can be obtained on application to the Secretary, Society of Arts, John-street, Adelphi, London, W.C.

A full list of the Cantor Lectures which have been published separately, and are still on sale, can be obtained on application to the Secretary.

"OWEN JONES" PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wall-papers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked, "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1908, when six prizes are offered for competition, each prize to consist of a bound copy of "The Leading Principles in Composition of Ornament of Every Period," from the Grammar of Ornament, by Owen Jones, and the Society's Bronze Medal.

INDIAN OCEAN METEOROLOGY AND ITS RELATION TO THE SOUTH-WEST MONSOON.

I wish to introduce to the members of the Society of Arts the subject of Indian Ocean Meteorology, seeing that it bears most forcibly on the agriculture and commerce of Western India, and deals with the failure, in 1905, of the south-west monsoon in different parts of India, a failure which has caused much anxiety throughout the whole of the Empire.

It is not my desire or purpose to go into the details of the widespread hardships and distress which a complete failure of a monsoon would entail; almost everyone knows only too well the heartrending history of the last famine in the Bombay Presidency. My object is to draw the attention of members to the meteorological variations of the Indian Ocean, in order that the subject may be discussed in such a manner as to induce members of the Indian Section, who are thus more directly interested in Indian affairs, both agricultural and commercial, to find a way to approach the Governments of India and of Mauritius to consent to the outlay of sufficient funds with the view of learning more of meteorology of the lands and oceans, which will be mentioned in the body of this paper, than is at present known. It is only by means of controversies and discussions among men of science and of acquired experience, that any really tangible matter can be obtained with which to construct a reasonable theory as to the causes of the monsoon rainfall, and of the reasons for its periodical failure. Unfortunately such discussions are few and far between, especially as regards nautical men, who are doubtless better able to throw light on the matter than any others. Having a record of twenty-five years under sail and steam in the Indian Ocean, I have necessarily acquired considerable experience in all matters climatic connected with this part of the globe.

There is not the shadow of a doubt that the atmospheric conditions of the Indian Ocean and Arabian Sea have considerably changed of late years, and the changes are probably still going on, but are unnoticed and unrecorded for want of more extended means of observation. I have often heard it asked, Is the desert creeping on, is it gaining in area as the world grows older? As time goes by will the coast line of Sind, Kathiawar, and Bombay become a rainless zone as is the Arabian coast on the west side? It is extremely difficult to assign the cause or causes of the partial or complete failure of monsoon rains, or of a late or early monsoon, but a combination of probable causes, however distant apart, may be put forward and discussed on their respective merits, from which some fairly reliable theory may be arrived at. The solution of the question of monsoon failures may even be found outside of India, and far distant from its shores. I believe the theory of excessive snowfall in the Central and Western Himalaya regions and its probable deterrent influence on rain-bearing currents was put forward by Mr. Blanford some years ago, and was for some time discredited. The failure of monsoon rains up to as late at least as the 8th September, 1905, when I left Bombay, has caused this snowfall theory to be revived with vigour. It has been remarked during the past few years that the winter and spring snowfalls do produce an effect on the monsoon rain-bearing currents. I believe the theory in connection therewith is this, if there is a great snowfall at these two periods of the season, and if that snowfall extends lower down the ranges and approaches the plains, it has a disturbing influence on the monsoon current, and causes drought. There is, however, another theory which we will do well to examine. In May, 1897, Sir John (then Mr.) Eliot, late Meteorological Reporter to the Government of India, in a tentative forecast of the expected monsoon, laid some stress on the normal or abnormal conditions of the south-west monsoon. At the time I supported his views in my "New Handbook of the Indian Ocean," and am now more convinced than ever that if a strong south-east trade is experienced up to near the equator a like south-west monsoon will blow to the north, and *vice versâ*. As far back as 1863, the late Dr. Meldrum, F.R.S., Director of the Royal Alfred Observatory at Mauritius, said: "Is not the south-west monsoon of the northern hemisphere from April to October a continuation of the south-east trade winds? When the south-west monsoon prevails in the northern hemisphere the south-east trade blows down to the equator, or beyond it, and the southern limits of the monsoon are in the immediate neighbourhood of the northern limits of the trade, both winds moving in a northerly direction." In August last, a writer in the *Pioneer* remarked that India was still floundering on the confines of meteorological science. May this not also be said of places in the immediate neighbourhood of India, and of localities within a certain radius of India? The snowfall theory more fully developed both in the northern and southern hemispheres may reveal much. This theory is credited with pretending that the snowfall has a deterrent effect on the rainfall of Upper India, and it may also be extended to the southern hemisphere, where excessive snowfall in the south Indian Ocean may also have the same effect on the rain-bearing currents coming up the Arabian Sea. One noticeable feature of the south-east trade in 1905 was its weakness from the equator to 20 degrees south, or say as far south as Mauritius, and the south-west monsoon has been of about equal force at the north. At Mauritius the wind as usual veered to south-south-east and south in June, and although light throughout June, July, and August, the polar winds were exceptionally cold throughout the island. The cold wind was felt and remarked, but no one ever gave a passing thought as to why it should have been so experienced. If we take, however, a glance at the map it will be at once seen that, directly facing the Bay of Bengal and Arabian Sea, we have numerous groups of snow-covered islands in the South Indian Ocean—namely, St. Paul, Amsterdam, Kerguelen, McDonald, Crozet, and Prince Edward Islands. Now, all these islands have heavy snowfalls in winter, and numerous icebergs are often grounded in soundings in their neighbourhood—especially Kerguelen Island—and icebergs have even been reported north of the 40th parallel of south latitude. Kerguelen Island is almost on the same meridian as Bombay, and the Crozet group is in a like position as regards Cape Guardafui. The cold wind blowing from the Pole is felt in Mauritius and neighbouring islands more or less according to the conditions of the snowfall and the quantity of ice to the south. May not this same current travelling toward the equator and beyond it have some disturbing effect on the rain-bearing clouds moving up the

Arabian Sea and towards Western India, so that the monsoon may be checked by excessive and late snowfall in the north, and by the same cause in the south so far as the Arabian Sea current is concerned? The distance of the islands I have mentioned from the south limit of the south-west monsoon regions and the deflection of cold currents from the southern ocean by intervening lands may be against my argument. but, taking into consideration that in these parts we know so little of aerial observations, and as we do know that cold currents tend to prevent precipitation, I consider myself justified in asking you to put faith in my theory, and my critics may also see their way to let me down lightly. Mr. A. Walter, of the Royal Alfred Observatory (Mauritius), in a paper read before the members of the Meteorological Society of that island, on the 6th July, 1898, said that their winter rains depend probably very much more directly on the temperature gradient over the South Indian Ocean than on any barometric conditions. The snowfall in both hemispheres may not be the sole arresting agency of rain-bearing currents. May not the variation of the meteorological elements of Africa, Arabia, and the numerous islands scattered over the Indian Ocean, be responsible for the sapping of rain-bearing vapour on which Western India so much depends for its rainfall at the regular season? It is an undoubted fact that vast atmospheric changes have taken place in these regions within a comparatively short period, and this disturbance of the regularity of monsoon rainfalls is not exceptional. For instance, the storm field of the South Indian Ocean has undoubtedly advanced westwards. A decade ago cyclones were unknown in the Mozambique Channel; now they are of annual occurrence. May not the unknown agency that has thus caused cyclones now to be regular yearly visitants in a region where they were formerly never felt be the same as is causing the cessation of the monsoon rains in India? That weather authorities in India place much reliance on the meteorological conditions prevailing in the Arabian Sea before the burst of the monsoon is evidenced by the attention paid to the reports of eastward-bound steamers between Aden and Bombay. The observations of such vessels can merely give a vague impression of general conditions, seeing that they can only report upon barometrical variations and markings in their immediate beaten track and over a very restricted area; whereas a hundred miles on either side of them a very different state of things may prevail. In order to arrive at a more definite forecast of the south-west monsoon a more extended system of regular observations is required, both surface and aeriel, in the southern hemisphere. A step in his direction was made at a meeting of the Meteorological Society of Mauritius in February 1905, when it was proposed by the Honourable O. L. O'Connor, and seconded by myself, that the Mauritius Government be approached for financial assistance to establish the kite system of aeriel observation on the principle adopted by the Weather Bureau of the United States. The Secretary, Mr. T. F. Claxton, F.R.A.S., promised to lay the subject before Government. The matter, however, is unfortunately still in abeyance if not entirely forgotten. May I be permitted to suggest to Members of this Society, and particularly to the Indian Section, that they should study the subject, and if it be considered of sufficient importance, that they should bring their influence to bear on the Indian Government, the Colonial Office, and the administration of Ceylon and Mauritius, with the view of obtaining their support, financially and otherwise, for the introduction of a proper system of aerial observations by means of kites as above alluded to, at some, if not at all, of the undermentioned places, viz., Keeling, Cocas, Mauritius, Diego Garcia, and Seychelles. Sakotra being almost in the track of the strongest monsoon current a station there would be of much value, but under present conditions this is not to be thought of on such an inhospitable shore. Mauritius and Réunion Island are now connected by cable. Perhaps the French Goverment may be induced to co-operate in this scheme of aerial kite observations and to establish stations at Réunion and at Mayotte in the Mozambique Channel, thus almost completing the circuit. That there are some hitherto unknown agencies disturbing the rain-bearing currents of the south-west monsoon of late years is only too evident. What these agencies are and how they are to be discovered is the task we have before us, and it is only by Government co-operation and assistance leading to more extended and continuous meteorological observations in the southern hemisphere can we hope to arrive at a more intimate acquaintance with these all important agencies.

C. W. BREBNER, F.R.G.S., M.S.A.

Master S.S. *Secunder.*

The writer hopes that the publication of this article may cause others to give some further information on the meteorology of the Indian Ocean, and the agency which prevents the rain-bearing clouds from travelling on to India during the south-west monsoon. Of late years rain has not only been arrested in parts of India, especially the Western Provinces, but the great island of Madagascar, and the lesser ones scattered about the Indian Ocean, Mauritius included, have suffered from a great scarcity of rain.

C. W. B.

Mauritius, 27th August, 1907.

OUT-DOOR ADVERTISING IN FRANCE.

The first enactment relating to the subject of out-door advertising in France is a law dated July 28th, 1791, which is still in force, and prescribes that only a Government poster or announcement may be printed on white paper; all others must be on coloured paper —red, blue, yellow, &c. Every poster or other announcement painted, printed, or otherwise delineated upon a wall, building, or upon canvas is subject to a yearly tax. Temporary "affiches" or posters are subject to a stamp tax, according to size. This is attached either in the form of stamped paper, on which the revenue stamp is applied to the sheet before being printed in such way that the stamp is cancelled by the text being printed over it, or it may be attached adhesively afterwards, and cancelled by a rubber stamp provided for that purpose. Before, however, being publicly displayed, each poster is required to be presented in duplicate at the office designated for that purpose, dated and signed either by the person in whose interest it is prepared or by the bill-poster who is charged with posting the same. According to the American Consul-General in Paris, such antecedent declaration must state fully (1) the text of the poster; (2) the name, surname, profession, and domicile of the person in whose interest it is to displayed; (3) the dimensions of the poster; (4) name, surname, and domicile of the bill-poster who is to post it in public; (5) the number of copies to be posted; (6) precise information as to the streets or squares, houses, or other constructions on which the poster is to be displayed, and (7) the length of time during which it is to be kept in view. One copy is filed at the office of registration, the other—signed and stamped by the official in charge—is returned to the applicant. It will be obvious that a system so rigid and elaborate as this gives the authorities of every village and commune in France absolute control of all posters and announcements displayed in public places, and practically suppresses the abuses which prevail in that respect in certain other countries. No one is permitted in France to deface streets and public places with crude, ostentatious announcements of his business or other subject. Bill boards are infrequent in Paris, and are generally built permanently into a wall, where they are taxed according to their superficial area. When a building is in course of construction and board screens are erected to shield the public from dust and other annoyance, such temporary screen will soon be covered with posters of amusements and other matters, but each poster so displayed has been previously submitted to the authorities, a license obtained, and each sheet bears the cancelled revenue stamp, according to its size. The department stores and other large popular retail establishments have permanent places in the stations of the Underground railway, and their coloured posters which are there displayed are in good taste, and often interesting as works of decorative art. The walls of market-houses bear permanent framed bill boards for the display of administrative announcements. Agencies for the sale of theatre, opera, and other amusement tickets are permitted to display coloured announcements of such performances inside their windows as posters, but the promiscuous placarding of patent medicines and drinks, on houses, fences, and dead walls is not permitted in France. There are in Paris various classes of kiosks or street structures which are devoted to advertising or bill posting, for example (1) round towers known as the Colonnes Moris, made of wood, and used mainly for posters of theatres and other places of amusement. This is the oldest form of kiosk in Paris, and comparatively few of them are now in use except on the leading boulevards and avenues. (2) The "Poste de Vigie" or policeman's kiosk. This is a hexagonal kiosk used as as shelter by the policeman whose post is adjacent to the more important cab stands. Its panels of wood or glass are used for the more permanent class of business advertising, which is printed on the glass or posters covered by glass frames. (3) The news-stand kiosks serve as a shelter and depot for dealers in newspapers and magazines whose stock is usually displayed on shelves or tables under a tent or awning set up outside the kiosk. In Paris kiosks of this class are common throughout the city. They are substantially built, and their panels serve for the permanent display of a large variety of advertisements. Electrical signs are permitted and used to some small extent in Paris, but not so generally as in Berlin, London, and some other European cities. For each sign of this class of public advertisement a special permit must be obtained from the prefecture, and the tax thereon is regulated by the size and character of the sign to be displayed.

IMPRISONMENT FOR DEBT.

The Return of the County Courts (Plaints and Sittings) just issued, which gives the returns for every County Court for England and Wales of the total number of plaints, nnd so on, entered in each Court from the 1st January to the 31st December,

1906 (both days inclusive), and of the sittings of the County Courts in England and Wales holden before the Judges of such Courts in 1906, supply some suggestive particulars as to warrants of commitment for the non-payment of debt. Table 12 shows that in recent years the increase has been considerable. In 1897, 307,035 judgment summonses were issued and 189,107 were heard. Of these, 112,096 were followed by warrants and commitments, and 7,727 debtors were actually imprisoned. In 1906, the number of judgment summonses issued amounted to 390,729, and of these 254,103 were heard; 152,759 warrants of commitment were issued, and 11,986 debtors were imprisoned. So that in the ten years the number of persons sent to prison for failing to pay their debts increased by over 50 per cent The difference in the practice of different County Courts is very marked. For example, Circuit 1 (which includes Alnwick, Berwick-on-Tweed, Gateshead, Newcastle-on-Tyne, North Shields, &c.) only issued 276 warrants of commitment, and imprisoned 43 debtors. And Circuit 59 (which covers a considerable portion of Cornwall only) issued 234 warrants of commitment and imprisoned 10 debtors. On the other hand, Circuit 16 (which has jurisdiction in Barnsley, Bridlington, Hull, Scarborough, and the neighbourhood) issued no fewer than 10,796 warrants of commitment and sent 1,002 debtors to jail, the next largest number of warrants of committal being on Circuit 18, and numbering 10,278; but here the debtors imprisoned only numbered 713. This circuit includes Doncaster, Newark, Nottingham, &c. It would seem that most of the debtors arrested for debt serve the period of imprisonment, the debtors who pay after actual imprisonment being few. Take, for example, a jurisdiction largely agricultural, like that of Circuit 52, which includes Calne, Chippenham, Devizes, Westbury, &c.; only two debtors paid whilst in prison; on the other hand, most of those who are arrested pay or are released before reaching prison. Thus, in Circuit 52, 630 debtors were arrested, and of those 587 were released without imprisonment. Even in a district like that covered by Circuit 47, which includes Greenwich, Southwark, and Woolwich, it will be found that out of 920 debtors arrested 583 paid before imprisonment, and on this circuit 248 paid or were released before the expiration of the term of imprisonment. A good many pay after the issue of the warrant but before arrest. For example, in this same Circuit 47, of 2,122 warrants issued, 352 were satisfied before the persons against whom they were issued were arrested. These figures, and others that might be quoted, would seem to show that whatever the true interpretation of the Act of 1869 under which these committals are made, and however much opinion may differ as to the expediency and equity of imprisonment for debt, the power to imprison does unquestionably bring about in a large number of cases the payment of debts that could not be collected until imprisonment was decreed, or enforced.

SMALL HOLDINGS.

The following circular has been sent by the Secretary of the Board of Agriculture and Fisheries to County Councils and County Boroughs in England and Wales :—

Sir,—I am directed by the Board of Agriculture and Fisheries to inform you that the Small Holdings and Allotments Act, 1907, comes into operation on the 1st January, 1908, and that, in view of the very important and extensive powers which it gives to County Councils, the Board would suggest that your Council should consider at any early date what steps should be taken to carry out the provisions of the Act in their county.

There are many matters of detail connected with the Act which are receiving the careful consideration of the Board, and as to these communications will be addressed to you from time to time, but the Board think it desirable to call the attention of your Council at once to the fact that the Act provides that County Councils may themselves take the initiative in preparing a draft scheme or schemes for the provision of small holdings for their county.

At a later period the Board hope to be in a position to nominate officers to confer with your Council as to the administration of the Act, but they would suggest in the meantime that your Council should at once set on foot preliminary inquiries as to the extent of the demand for small holdings in their county and as to the possibility of satisfying those demands by the acquisition of suitable land either within or without the county. The Board are of opinion that these preliminary enquiries should be as little formal as possible and they think that no better method could be adopted than to invite the individual members of the Council to interest themselves in the matter by making informal inquiries in their respective districts.

It will also be necessary that the provisions of the Act should be made known to the class who are likely to take advantage of it, and in this connection I am to observe that experience has shown that very useful information is often obtained by the insertion in the local newspapers of advertisements, framed in simple language, inviting applications from men who desire land for small holdings, and requesting applicants to forward particulars as to the quantity of land desired, the locality preferred, the extent of their experience in agriculture and the amount of their capital. With this information in their possession your Council would be in a position to consider the steps to be taken to satisfy the demand so soon as the Act comes into operation.

I am further directed to call the attention of your Council to the fact that the small holdings provided by County Councils under the Act of 1892 have in no case resulted in any charge being placed on the rates of the county, and that where small holdings are provided under the Act of this year the possibility of any such charge arising has been very considerably diminished. Under Section 17 of the Act the Board are authorised, subject to regulations to be

made hereafter by the Board with the approval of the Treasury, to repay to County Councils the whole or any part of the expenses incurred by a Council in relation to the acquisition of land for the purposes of small holdings (other than the purchase money, or any compensation, or rent payable in respect of the land), and in pursuance of Section 14 of the Act, the term for the repayment of loans for the purchase of land may be extended to 80 years, and County Councils will be able to borrow from the Public Works Loans Commissioners on favourable terms. In addition, in cases in which the carrying out of a scheme under the new Act, has resulted or is likely to result in a loss, one-half of that loss will be borne by the Exchequer subject to certain conditions which will be set out in a Treasury Minute to be subsequently issued.

I am to add that the expression "County Council" in the Act of 1892 and in the new Act includes the Council of a County Borough.

Copies of the new Act are now obtainable, either directly or through any bookseller, from Messrs. Wyman and Sons, Ltd., Fetter-lane, London, E.C.

(Signed) T. H. ELLIOTT, *Secretary*.

SWISS STRAW GOODS INDUSTRY.

The canton of Aargau, of which Aarau is the capital, is the centre of the straw and imitation straw goods industry of Central Europe. The people of this canton have for many generations been interested in the industry, chiefly because the labour of the peasants has been obtained very cheaply, and they could profitably produce the articles of real straw, on which the proportionate cost of the hand labour required (as compared with the cost of the raw material) forms an enormous percentage of the cost of the finished article. In writing of the present straw goods industry, so-called, a large number of imitations of straw must be taken into consideration. In fact, not more than 5 per cent. of all the output consists of real straw. The American Consular-Agent at Aarau says that in a single list of samples of straw goods recently submitted to him, are included the following materials, which represent articles shipped in the form of finished hats, braids, or bindings, in dozens of colours and finishes, and sold under the generic name of "straw goods:"—Sample 1 consists of wood chip and silk woven together; No. 2, wood chip and ramie; No. 3, "straw" braids of pure silk; No. 4 real horsehair made up with straw and cotton; No. 5, real silk and straw; No. 6, artificial silk and straw; No. 7, silk and ramie; No. 8, ramie; No. 9, cotton; No. 10, wood chip; No. 11, Jedda, or chow-chow; No. 12, woven fancy straw; Nos. 13 and 14, fancy articles made by peasants. The straw used in the manufacture of real braids is usually rye straw, and long of joint. Each peasant, as a rule, grows his own straw, and as soon as his summer farming is over, and his crops gathered in, he and his entire family set to work to split and arrange the straw in the various widths required by the manufacturers; and then the lengths of straw are knotted together, and the resulting thread is made into large hanks, 18 inches long, and tied in bundles ready to be sent to the manufacturers. It is often a matter of surprise that the Swiss can produce articles requiring so much arduous labour at such very low prices. To understand the question it is necessary to study, to a certain extent, the sociological side of the peasant life. Of course, during the summer their work is largely in the fields, but the moment the crops are harvested, and the wood cut and stored for the winter, the entire peasant family engages in indoor work, such as weaving or knitting on the hand looms, which are always lent to the peasant by the large manufacturers of knitted and straw goods. The Consular Agent says that he knows personally of one family of peasants, and this is not an exceptional case, but is typical of probably 75 per cent. of these peasant families, who work during the six winter months of the year at three looms weaving narrow silk and cotton tapes. This family consists of four persons who are grown up, and seven children, whose labour is available out of school hours, and every winter for several years two of the looms have never stopped day or night, except for oiling or the introduction of new raw material. The third loom is run only during the day time by the younger children when home from school. These peasants are industrious and sober people, and are satisfied with a daily profit on the work of the entire eleven members of the family of from four shillings to five shillings and sixpence per day on the whole of their output for six months of winter. This is characteristic of the labour of the Swiss, and especially of the unskilled labour, which produces the straw and imitation straw braids enabling the Swiss manufacturers to ship even to the United States, in spite of American duties, in competition with American workmen. After straw itself silk and imitation silk materials are the products which would be considered of the greatest importance, used in the straw goods industry. Indeed, except for the use of its name, straw plays an exceedingly small rôle in the industry as the following percentages of the manufactured products sold will show. Naturally, these are only approximate, but generally speaking correct. On an output of 100 per cent. in value, the result is as follows:—Tussah silk, 30 per cent.; real China and Japanese mulberry silk, 10 per cent.; artificial horsehair, 15 per cent.; cotton, 10 per cent.; straw, 5 per cent.; ramie, 20 per cent.; and miscellaneous fibres and horsehair, 10 per cent. The real Chinese and Japanese silks made by the worms fed on mulberry and similar leaves, are much too expensive to be used very largely in the industry, but a very large amount of Tussah silk obtained, largely in Manchuria, from worms fed on oak leaves, is annually consumed in Switzerland. Naturally it takes the dye very well, and is fairly light and durable. It is woven into threads of various thicknesses, and again these threads

are made into narrow ribbon-like braids, which are dyed and finished as required. Imitation horsehair is a cellulose product, and is furnished to the manufacturers in the form of thick threads of every imaginable colour, by a German manufacturing trust, with headquarters at Frankfort. This thread is finished and made into braids in the same way as the real silk or real horsehair is prepared. Horsehair is now only used for white or black braids, as it does not take the dye so well as the imitation. It is said that the trust could sell the imitation produced for one half the price now obtained for it, and make a good profit, but at the present price it is only about 60 per cent. of the cost of the real horsehair, and as they control practically the entire output, they keep the price up. Wood chip or wood shavings are used in Switzerland to a certain extent, but it is in Japan that they play really an important part in imitation straw goods. Certain kinds of pine and oak are largely used, the shavings being made with, or across the grain, according to the class of wood used. The finished product is light in weight and fairly durable, but it lacks the qualities of taking the dye satisfactorily, and is generally used only in its natural straw colour. Cotton and hemp are also used in increasing quantities each year, but do not play an important part as yet in the Swiss industry. Certain other plant fibres are used, and even the barks of some trees are required for special purposes. A material known as "Bois de Bohème" is largely used in Italy for certain cheap straw hats. Jedda fibre is a material which would be very largely used if the price of the raw material were not so high. It is part of a plant somewhat resembling an onion, and comes from the island of Réunion. It is a most durable, extremely light, strawlike material, and takes dye as perfectly as silk. The price varies very much from year to year, owing to the uncertainty as to the quantity which the natives will offer for sale. It has been sold as high as 18s. 6d. per pound, and at present it is as low as 2s. 4d. per pound. Jedda fibre is generally known in the trade as "chow-chow." Ramie, of which the importance to the straw goods industry is increasing enormously each year, is a flax-like fibre, obtained from the leaves of the plant of that name, grown largely in India and Manchuria. The cost of the raw material alone prevents its general use by the trade. The large leaves of the plant, resembling somewhat tobacco leaves, are steeped in water, and then by hand the tough veins of the leaf are withdrawn and twisted together, and the whole is "carded," if one may use the term, and prepared somewhat as hemp is prepared, and is furnished to the straw manufacturer in balls some nine inches in diameter, resembling raw cotton drawn out into long strands or ropes. These soft ropes of ramie are passed through hot gelatine baths, and on leaving the bath each thread is passed between two rollers and subjected to immense pressure, the result being a ribbon of the thickness of straw, and about an inch wide. This ribbon is passed through drying chambers, and is finally ready for dyeing or for being cut into the widths required for braiding, &c. Ramie takes dye more satisfactorily, and it is believed that it will gradually replace nearly all other similar materials used in the trade. After the finished dyed threads or bands of straw, or any of the above products, varying all the way from one-sixty-fourth to one inch and a half in width (the latter being obtained by fastening together the narrow bands), have passed through the different processes, they may be passed through various machines to give them a certain surface finish, as, for example, a stippled effect, or a lined surface, or rough, or smooth, or puckered finish.

WINTER-ROT OF POTATOES.

The fungus (*Nectria solani*, Pers.) is one of the commonest diseases of the potato. It attacks stored potatoes, and is always present to some extent, but usually only reaches the proportion of an epidemic during hot, dry seasons, which favour the rapid development and spread of the fungus. The tubers only are attacked, and inoculation, by spores present in the soil, takes place when the tubers are young; but, as a rule, the disease is not obvious when the tubers are lifted, although the mycelium of the fungus is present in the tissues. The further extension of the disease depends entirely on circumstances. If the potatoes are kept dry, and exposed to the air, no further development takes place. On the other hand, if they are stored or placed in heaps so that air is practically excluded, and more especially if stored before being perfectly dry, sweating takes place, the temperature is raised, and within a few weeks the mycelium present in the tubers commences growth.

Description and Life History.

The first external indication of disease is the gradual depression and shrivelling of a portion of the surface of the tuber; these sunken portions are soon covered more or less with white patches of the fungus, bearing myriads of spores, which are quickly distributed by mites and other minute creatures.

At a later stage the white tufts change to a pale pink colour, and produce a second crop of spores, which in like manner are distributed through the heap of potatoes by mites, &c. By such means, the disease quickly spreads, and, aided by bacteria, the tubers are soon reduced to a soft, fœtid mass, the skins alone remaining intact.

During the following season, the most perfect stage of the fungus, in the form of minute crimson-red points, develops on the skin of diseased tubers. The spores of this stage germinate in the soil, and infect future crops.

Prevention and Remedy.

1.—The best preventive against an attack of winter-rot, is to make certain that the potatoes are well dried before storing. Powdered sulphur, if sprinkled over the tubers at the rate of 2 lbs. to the

ton, will destroy the fungus, and also hold in check mites, woodlice, &c., which, by their movements, convey the spores from one potato to another. "Pits" or "clamps" should always be well ventilated.

2.—Land that has produced a diseased crop will certainly be infected, and potatoes should not be planted in it again for some years. Kainit, or lime, may be applied to infected land. Both destroy the fungus. The former is the more effective, and when land is infected, this manure should be used in preference to sulphate or muriate of potash; but the quantity should not exceed 5-6 cwt. per acre, or the quality of the potatoes may be injured. Kainit may be applied in the drills before planting; but in this case, where it is required both as a manure and a fungicide, it would probably be better to apply it as a top-dressing before the horse-hoe is used for the last time.

If the land needs potash, and especially if the potato crop is to be followed by a crop likely to be benefited by potash, as *e.g.*, barley or mangolds, a dressing of kainit may be applied to the infected land as soon as the potatoes have been lifted. If potash is not required, and if the land is likely to be benefited by lime, then it would be desirable to dress the affected field with from 1 to 3 tons of lime per acre.—*Leaflet of the Board of Agriculture.*

CONDITIONS OF SCIENCE WORK IN SECONDARY SCHOOLS.*

In a paper on the "Internal Economy of School Science," read before the Public School Science Masters' Association, in January, 1907, figures were presented relating to conditions of science work in thirty-six public schools. More recently similar data have been obtained from about the same number of secondary schools, working in conformity with Board of Education methods.

In both cases information was asked for on the following points:—Number of boys taking science in (1) general course, (2) special course; average number in class; number of hours per week for (1) general course, (2) special course; number of science masters; number of laboratory assistants; approximate annual expenditure for science; and answers to the following questions:—Do you consider your present arrangements to be adequate in respect of—(1) laboratory accommodation, (2) laboratory equipment, (3) staff, (4) laboratory assistants?

The average results may here be given:—

Public Schools.—In twenty-nine schools 60 per cent. of the boys take science: in twenty-three of these the average percentage of boys in the general course is ninety-five, the remainder being specialists. The number in class for twenty-seven schools is 21·5 in the general and fourteen in the special course. The time for the general course is four hours a week. usually divided between chemistry and physics, and for the special course twelve hours. In eighteen schools the annual expenditure per boy was about £1. Chemistry costs more than physics for maintenance. In twenty-three schools there is a science master for every seventy-six boys, and a laboratory assistant to every 147 boys. Sixty-five per cent. of the correspondents were satisfied with their laboratory accommodation, 71 per cent. with equipment, 77 per cent. with the number of the staff, and only 58 per cent. with laboratory assistants.

Secondary Day Schools.—All boys above twelve years of age take science. The percentage of boys in the general course, lasting four years, is 94, in the special course 6. The average number in class in the general course is 22·6, in special course 8 or 9. The number of hours for science in general course is rather over four a week, and in special course from eight to fifteen. The work is usually divided between chemistry and physics; very little biology is taught. The annual expenditure per boy for apparatus and chemicals is 8s. 6d., or 2s. for one hour of science a week. The average number of boy-hours a week for one science master is about 310. There is one laboratory assistant to 218 boys. Ninety per cent. of the correspondents are satisfied with their staff, 77 per cent. with laboratory accommodation, 80 per cent. with laboratory equipment, and 50 per cent. with laboratory assistants.

It will be seen that the ratio of specialists to boys in a general course is roughly the same in the two classes of schools. In the matter of expenditure the day schools are markedly inferior to public schools. In both there are too few laboratory assistants. The consequences of this misguided economy are that the time of the science master is wasted in drudgery which could be performed less expensively by an assistant, and opportunity for preparation of experiments is lacking.

In answer to the question, "What do you consider to be the maximum size of a laboratory division for successful work?" the average reply from thirty schools was:—Twenty boys in the lower classes, twelve in the higher. It need not be said that these figures still represent only a pious aspiration in many

Another question addressed to the same schools related to the advisability of teaching experimental mechanics as part of the science course. The answers showed a strong feeling of the value, and even necessity, of such a course as a preliminary to all advanced work in physics.

It is to be hoped that this report, fragmentary as it is, may be of some use to educationists and those interested in the supply of secondary education, as indicating the present conditions under which science work is prosecuted in public schools and the better class of secondary day schools.

* Abstract of a paper by R. E. Thwaites, M.A., Wyggeston School, Leicester, read before Section L of the British Association, at Leicester.

DAY TRADE SCHOOLS FOR GIRLS.*

The experiment of day trade schools for girls is still in its infancy in this country, but the promising infant has a great future before it. The standard of wages and conditions of work of women in industry is even lower than that of men. This is due to the fact of woman's double work-wage earning in factory or workshop and the responsibilities of home. The former is apt to be looked upon as temporary and comparatively unimportant, whereas men look upon their trade as their life work. This tendency is disastrous to the 4,000,000 women wage-earners of the country.

To raise the conditions the training for industry must be taken more seriously. At present there are few opportunities for such training. Evening classes are comparatively valueless after girls have worked at trade all day. The Women's Industrial Council has pressed upon the London County Council the need for day trade schools for girls. In October, 1904, the London County Council started the first of these — that for waistcoat making — at the Borough Polytechnic. Now there are, in addition, schools for dressmaking and upholstery at this polytechnic. Also there are classes for ready-made clothing and upholstery at Shoreditch Technical Institute; for dressmaking at Paddington and Woolwich; and for dressmaking, corset-making, and ladies' tailoring at Morley College — to be moved in the autumn to special premises in Westminster, where classes for laundry work are also planned. The broad lines of instruction are the same in each.

Altogether 280 girls are now receiving instruction, and this number will be increased in the autumn. The pupils attend after leaving elementary schools, most of them having scholarships with maintenance grants, and the course is about two years in length; six half-days a week are devoted to trade teaching; four half-days to general instruction, including art work, book-keeping, writing of business letters, and so forth, in close connection with the trade work. The trade teachers are in each case women who have come straight from good positions in the workroom, and who are closely in touch with trade methods. Each class also has an advisory committee of trade experts, employers, foremen, and others, who visit regularly, and give most helpful criticisms and suggestions important to gain the confidence of the trade. Mrs. Oakeshott, the L.C.C. organiser, gains knowledge of conditions in workshops and factories, and helps schools to keep up-to-date.

The girls begin with easy exercises, and soon proceed to more and more varied and elaborate work, instead of beginning, as in the workroom, with running errands and being kept at drudgery tasks to suit the convenience of older workers. The fundamental difference is that in the school the pupils' development is the first consideration; in the workroom, the customers' convenience. The youngest or slowest pupil has the special attention of the trade teacher and the expert advisers, and the use of good materials to practise on, even at the risk of spoiling them. They are also taken to see the best shops, museums of art work, and so on. Another especial advantage is that the hours are short, and the pupils do not get the backache, anæmia, and general weariness which fall to the lot of the girl of fourteen who goes straight from school to work ten and a half hours, or even more, daily in the season.

It is remarkable to see how the girls respond to this teaching. Girls of thirteen and fourteen manipulate blouses and evening dresses in best West-end style; make waistcoats which evoke the enthusiasm of their teacher, who herself "sees something fresh to admire in her trade every day;" and design at their art lessons ornamentations and traceries for embroidery which are tasteful and graceful. The girls are at first made to do the work thoroughly and gracefully, without being hurried; but during the second year they are gradually speeded up and made to work to time. We have not yet much knowledge of what the girls can do when they go out into the trade, but so far as we have any, amongst the Borough scholars, it is encouraging.

It is hoped that the girls now being trained will be equipped by their thorough grounding and insight into all branches of the trade and their higher level of general knowledge and intelligence to rise to the best positions in the trade. If the numbers are increased, and the operations widened, the level of the average worker will be raised, and every girl will be given a chance of being a good all-round hand, taking pride and pleasure in her work; whilst the union in the school of the art and science teaching with the practical details of industry foreshadows a gradual revolution in our trade methods which will raise our industries to a perfection hitherto only pictured by dreamers and idealists.

* Abstract of paper read by Mrs. J. Ramsay Macdonald before Section L of the British Association, at Leicester.

WOOD-PULP INDUSTRY OF NORWAY.

The Board of Trade Journal contains some particulars of this industry taken from a report by H.M. Consul at Christiania (Mr. F. E. Drummond-Hay):—

During the last forty years the quantity of paper consumed has increased so rapidly that the wood-pulp industry has developed in a remarkable way. In Norway it has made wonderful progress, and for some time past Norwegian wood-pulp has held a prominent place in the world's market. A large proportion of the pulp produced in Norway is consumed in the country itself, the manufacture of paper having also made great progress. The export of Norwegian paper in 1906 amounted to 97,143 metric tons, having a value of 16,353,200 kroner (£908,511).

The following table shows the amount of wood-pulp exported from Norway during the years 1902-6:—

	Metric Tons.	Kroner.
1902	447,470	24,736,800
1903	447,744	23,876,600
1904	445,260	24 290,600
1905	442,325	27,620,400
1906	505,627	31,982,400

Of the 505,627 tons of wood-pulp exported during 1906, 362,228 tons was moist mechanical, and 122,923 tons dry chemical.

Sweden, Finland, and Canada are Norway's most serious competitors. The export of wood-pulp from Sweden in 1906 was 414,811 tons, while that of Finland amounted to 56,181 tons.

The prices of wood-pulp have declined considerably since the industry was started. For example, the moist mechanical pulp, which in 1867, 1870, and part of 1874, realised 150 kroner per ton, in 1891 fetched only 29 kroner, a price which left no profit to the manufacturer. The prices of the different kinds of wood-pulp during August, 1907, f.o.b. at Norwegian ports, were as near as possible as follows :—

Dry mechanical wood-pulp, about 95 kroner per ton.
Moist ,, ,, ,, 50 ,, ,,
Dry chemical ,, ,, 145 ,, ,,

The first Norwegian wood-pulp factory was established in 1868. There are now 72 factories, of which 53 are for mechanical wood-pulp and 19 for chemical wood-pulp. Sufficient motive power is furnished by Norway's natural waterfalls; the machinery used in the factories is almost entirely of Norwegian manufacture. A large quantity of Norwegian sulphur pyrites is used in the manufacture of chemical wood-pulp.

About 21 per cent. of the area of Norway is covered with forests. It is feared, however, that in course of time the pulp factories will exhaust the forests, owing to the very small dimensions of wood required in the chemical would-pulp mills. Every year the State plants at least 1½ million trees in the public forests, in addition to which a large number are planted by private owners.

THE INEBRIATES' ACT.

In the report required by Statute concerning institutions certified and licensed under the Inebriates' Act just issued, Mr. Branthwaite refers to the financial reasons for the committal of inebriates to reformatories. Every year's experience, he says, adds its quota of evidence in support of the necessity for the existence of special institutions for the control and treatment of inebriates. In his opinion the cumulative evidence points to three different conclusions :—

(1.) That all habitual drunkards who render themselves liable to be dealt with under the Inebriates' Act of 1898 have become temporarily or permanently diseased, and have passed beyond the limit of responsibility.

(2.) That any attempt to frighten such persons into sobriety by repeated fine or imprisonment has proved useless, and

(3.) That some more satisfactory method is urgently needed to afford the victim a real chance of recovery, or if recovery is passed hope, then to save society from the malicious, criminal, or indecent results of his drunken habits.

In Mr. Branthwaite's opinion the only possible remedy is the substitution of long continued reformatory treatment for the prison methods which still largely obtain. Hitherto more attention has been paid to the humane and scientific aspects of the problem than to the economic. Mr. Branthwaite now puts into concrete form some of the arguments which lead to the conclusion that economic advantages accrue from the curative detention of reformable persons, who if not yet a continuous charge upon public funds must become so if allowed to continue their progress towards hopeless degradation.

If an habitual drunkard is to be reformed, it needs some very energetic measures to prevent him or her from being a regular charge upon public funds for the remainder of life. The only hope for such a case consists in early and long-continued treatment. If the case is taken in hand early, whilst still reformable, the country has to face three years of detention as the only means of avoiding expense throughout the life of the inebriate. If the cost of reformatory detention is brought down to a figure which compares approximately with the cost of the inebriate under conditions of intermediate freedom and prison, then the economist loses practically nothing by imposing reformatory detention during these few years, and gains by standing a reasonable chance of converting a wastrel into a wage earner. Mr. Branthwaite contends that so far as comparatively irreformable drunkards are concerned, reasonable expenditure upon continuous detention is still more justifiable.

"Every case of this character has already become a heavy burden upon public funds, and will probably remain so long as life lasts. In regard to these cases, continuous detention merely uses money (now spent fruitlessly) in a manner more likely to result in protection to the community and possible benefit to the drunkard. As at present spent the money benefits the community but little, and the inebriate not at all."

Mr. Branthwaite gives the prison history of a case sent to a reformatory, the case of a female, whose first conviction was in January, 1881. When she was fifteen years and nine months old she was convicted of being drunk and disorderly. Since then she has been convicted 458 times, or rather had been at the date when his list was made up. There is not a single year from 1881 onwards in which convictions are not recorded against her. Drunk and disorderly, disorderly and obscene, assault, felony, wilful damage, attempted theft, begging. These are the charges upon which again and again in each year she has been found guilty. The record is incomplete because the woman's wanderings have made it impossible to compile a complete history.

"Every scheduled item in her history," says Mr. Branthwaite, "means expense, beginning with main-

tenance and police cells, and the occasional services of police surgeons when arrested in a drunken and comatose condition. Then follows the cost of her maintenance in prison during a great part of each year. The cost of every hearing at the Police Court, committal for trial at Assizes or Sessions, and the subsequent expense of such trial, Court charges for entering recognizances and returning convictions, witnesses fees, cost of summonses and the preparation of warrants of committal to prison, her carriage backwards and forwards (with escort from Court to prison) and her expenses back from prison after the termination of each sentence to the town to which she belongs. There are other charges which she imposes upon the tax and rate payer; and, in addition to this, chronic and apparently irreformable drunkards reproduce their like, and by their influence and example manufacture others of their kind. They become insane, and add to the lunacy bill, or they become diseased, decrepit, and prematurely aged, to be a burden upon the charges of the Poor-law."

Continuous reformatory detention saves the majority of these expenses. During the detention the community escapes danger and annoyance, and the drunkard has a chance of recovery, which the short sentence prison method does not give. The conclusion seems irresistible, that reformatory detention at reasonable cost is the most logical and economical method of dealing with the comparative irreformable, provided recommittal is frequently resorted to in order that detention may be made as continuous as the law permits.

COPPER MIRRORS.*

The importance from the point of view of the health of the workpeople of obtaining a substitute for the tin amalgam used in the manufacture of mirrors has led many chemists to study the conditions under which metals are deposited from aqueous solution. These investigations have, however, usually had for their object the preparation of a liquid which would deposit a uniform and coherent layer of silver over a a large glass surface at the ordinary temperature. Liebig was the first to solve this problem satisfactorily, and his method in which milk sugar is the reducing agent was formerly extensively used.

Other metals are not so easily deposited, and copper, which from its close relationship with silver one would expect to behave similarly, has never been observed to be laid upon glass. Although copper mirrors have never been obtained by deposition of the metal from an aqueous solution, Faraday † about the time when silver mirrors were attracting much attention made the interesting observation that a mirror-like deposit could be obtained by dissolving a little oxide of copper in olive oil and heating plates of glass in a bath of this liquid up to the temperature at which the oil decomposes. The mirrors, however, obtained by Faraday's method, if of any size, are liable to be stained or discoloured in patches by decomposition products of the oil, and they are, moreover, generally lacking in brilliancy. Further, as the deposition of the metal only takes place when the oil decomposes, the process is excessively disagreeable to carry out; and since the oil is spoiled it is also somewhat costly.

In the course of an investigation on the oxidation of aromatic hydrazines, the author made the observation that when solutions of cupric oxide are reduced by these compounds the metal is deposited upon the glass in the form of a brilliant coherent film if clear vessels are used.

The mirrors obtained by this method are very beautiful, as they show the lustrous red colour of burnished copper, and are as perfect in reflecting surface and as uniform as the similar mirrrors obtained by the deposition of silver.

It seems probable that this method of depositing copper upon glass could receive important application in the production of objects of art.

*Abstract of paper read by F. D. Chattaway before Section B of the British Association, at Leicester.

† Phil. Trans., 1857, p. 145.

INDIA'S INSECT PESTS.

The tea planters in India have great trouble on account of insects which attack the tea plants. The bark-eating borer, the sandwich caterpillar, the mosquito, and the white ants all attack the plants and do immense damage. The white ant, according to the American Consul-General at Calcutta, is one of the most destructive of all the insect pests of India, there is no wood that resists its attack except sandal-wood. It delights in reducing white pine or white wood to powder. The ant cannot work in the light, it must get at the wood from a dark recess and work within a shell. It will, in some mysterious way, get into a veneered picture frame, or one with a thick coating of lacquer, and in a short time, only the veneering or lacquer remains, while the white wood body of the frame is found to be entirely reduced to powder of the finest sort, and but little of the powder remains, the ant having consumed the bulk of the wood. Its method of destuction is by emitting a kind of acid, which deteriorates the wood. The Consul-General says that an acquaintance of his was absent from his home for a few months. He covered his furniture and prepared thoroughly, as he thought, against the ravages of insects. On his return he sat down in a chair that had been carefully covered, and it crushed down beneath his weight as if it had been made of cardboard. Upon examination it was found that the white wood body of the chair had been eaten out by white ants, leaving only the veneering and gold-leaf covering. The other chairs of the set were examined and all were found to be in the same condition. The furniture appeared intact, but the moment it was touched it crumbled into dust. The

ants will get into joists and eat away the centre, leaving only shell. Several long joists thus eaten out have been replaced in the American Consulate by iron ones. The white ant is the curse of the country, and there seems no way of exterminating it or of preventing it from getting into mischief. This is one reason why the natives build their houses of mud even where timber is plentiful. The finest houses in the large towns and cities are constructed in a way as far as possible to cover, or imbed woodwork in cement. Especially the ends of wood structural work are thickly covered with cement to prevent the boring of white ants. Most of the floors, as well as walls and ceilings are covered with cement. The white ant is a source of considerable anxiety to tea planters, and the entomological station of the Indian Tea Association is investigating the matter with a view, if possible, of protecting tea plants from this and other pests, including the green fly, which of late has been giving a great deal of trouble.

ADMIRALTY CHARTS.

The following is the official list of charts issued by the Hydrographic Department, Admiralty, in August, 1907:—

New Charts.—No. 2881—Gulf of Mexico:—Key west harbour and approaches; plans of Key west harbour and north-west channel bar. 1739—China:—Chu-Kiang or Canton river, sheet V.; Whampoa channel and Changshan island to Canton. 3649—Tasmania, north coast:—Entrance to river Tamar. 2799—South America, west coast:—Plans on the coast of Ecuador and Peru. Plan added:—Port Bayovar. 1115—China, north-east coast:—Yang tse kiang, sheet V.; Yo-chau-fu to Kwei-chau-fu Plans added:—Sketch of Tching Tan; sketch of Kung Ling Tan. 1268—Plans in the Kuril islands. Plans added:—Shari road, Rausu road. New plan:—Anama harbour.

Charts that have received additions or corrections too large to be conveniently inserted by hand, and in most cases other than those referred to in the Admiralty Notices to Mariners.

1188—The World:—Coal and telegraph chart. 1481—Scotland, east coast:—River Tay. 2495—Ireland, south coast:—Kenmare river, &c. 3158—Norway:—Nevlunghavn to Torbiornskier, &c. 3159—Norway:—Torbiornskier to Jæløen. 881—Norway:—Aakre to Hisken, &c. 2309—Norway, sheet VII.—Leka to Donnæsö. 2628—Malta island, south-east portion. 644—Africa, east coast:—Delagoa bay (*Lorenzo Marques*). 216a—Bay of Bengal, Mergui archipelago:—Lord Loughborough island to Mergui. 3612—China, south coast:—Port Shelter and Rocky harbour. 1760—China, east coast:—The Brothers to Ockseu islands, &c. 2513—New Zealand:—Napier port and harbour.

These charts are issued by Mr. J. D. Potter, 145, Minories.

HOME INDUSTRIES.

The Hop Crop.—The brilliant weather of September greatly improved the hop crop outlook. Estimates of the total crop vary considerably, but it would seem safe to say that it will exceed 400,000 cwts. The acreage is 44,938, and given 9 cwt. to the acre there would be a total yield of 404,442 cwts., or no less than 158,442 cwt. in excess of last year's yield. Owing to the lack of sunshine in August the hops are small but they are of good brewing quality, and of fine flavour. The average yearly consumption of hops in the United Kingdom is a little over 600,000 cwts.. but considerable stocks are held by brewers, and the crops in the chief hop-growing districts on the continent are exceptionally heavy, so that brewers have no cause for anxiety as to a possible shortage of hops. Unfortunately for the home grower prices are not on a remunerative basis. In a recent circular Messrs. Mangar and Hanley put the position accurately when they say, "Compared with thirty years ago more hops are now obtained per acre—science in farming and skill in the handling producing larger averages—but notwithstanding these advantages the commercial results point to a very serious loss of capital, and the existing state of the trade unhappily indicates a further decrease." The shrinkage in the area of culivation shows small sign of slackening. In 1905 the area under hops was 48,968 acres, last year 46,722 acres, this year only 44,938. Last year the reduction was over 4 per cent. on the 1905 acreage, and this year it is over 3 per cent. on 1906. In the last ten years the reduction has been nearly 10 per cent. It is not easy, or perhaps possible, to suggest a practicable remedy for this regrettable contraction. Many causes have combined to bring it about, and these causes are still operative. It is a noticeable fact that something like three-fifths of the breweries of the Uuited Kingdom refuse to use foreign hops, and depend wholly upon the home growth, but fewer hops are used in proportion to the brewers output than formerly. It has been suggested that a conference of the trade be held to consider whether anything can be done to encourage the hop growers, and whilst something might come of it such a conference could do no harm. It is certain that the acreage under hop cultivation will continue to decrease unless the average of prices can be raised, and the present comparatively high price of wheat, and the prospect of a further considerable rise, will quicken the inclination to grub up. It is not to the interest of the brewers that this grubbing process should continue. Some at least of the money spent by the brewer at home for hops comes back into his coffers, but none of the money he sends abroad for foreign hops returns to him. It is to his interest to see the home cultivation maintained and increased, but as things are further shrinkage seems certain.

Coal Miners' Profits. — Much is being said just now about the excessive profits that are being made by coalowners, and it may be interesting, therefore,

to refer to an analysis of working costs made by Sir Christopher Furness, and submitted by him last week to a meeting of colliery shareholders. Sir Christopher Furness submitted his analysis to Messrs. Holmes, Spencer and Co., who, it may be mentioned, are the chartered accountants employed by the miners in the quarterly assessments of prices on which wages are based, who endorses it. Reduced to percentages, the analysis shows that for every £100 spent by the company with whose accounts Sir Christopher Furness was dealing, accounts said to represent a fair average of the trade—52·44 per cent. went to labour directly in money; 5·66 for rates, coal and house rent—that is interest on capital spent in building miners' houses; 1·80 per cent. to labour for management at collieries, harbour, head office, &c.; making a total for labour of 59·90 per cent. Materials cost 6·63 per cent.; provender for pit ponies, 1·36 per cent.; shipping charges, 1·55 per cent.; railway dues, 1·24 per cent., which are largely made up of wages, making a total of 10·78 per cent. Then rates and taxes accounted for 1·35 per cent.; coal trade calls, including compensation for accidents, horse depreciation, damaged land, insurance, &c., 2·72 per cent.; redemption of manor arable royalty, 1·04 per cent.; royalties, rent, way leaves, 4·21 per cent.; Reserve Funds for depreciation, 9·49 per cent.; remuneration to capital, 10·51 per cent. If the actual cost of production is taken—that is, money expended in raising coal, exclusive of reserves for depreciation and remuneration of capital—labour receives, according to these figures, 75·87 per cent. Sir Christopher Furness's comment is as follows:—"These figures do not bear out the contention that capital is overpaid. even in a good year such as that to which they relate, and for four years ordinary shareholders received nothing." If this fact is considered, the return on capital is reduced to 6·73 per cent.

Wolfram and Tungsten.—A few years ago wolfram ore could not be sold at £15 a ton, and the world's output was only about 300 tons. But since then there has been a steady growth of demand, and the output last year was about 3,500 tons, whilst the price had risen to £150 a ton. It is found for the most part in Boulder County, Colorado, although some is obtained in Northern Queensland, and a little in Cornwall, where, however, the ore deposits of wolfram, as a rule, are small and irregular. Tungsten of soda is prepared from wolfram, and is used with starch for rendering light fabrics, such as muslin, uninflammable. It is also the chief substance from which tungsten acid is derived, and metallic tungsten is prepared from it. In recent years this has been largely used in Sheffield for hardening high-speed and special tool steels, some of which contain up to 20 per cent. of tungsten. The rareness of the metal, and its high price—metallic tungsten has been selling at £450 a ton—has prevented its being largely used, but large deposits of wolfram are being opened up in Colorado, and a company is being formed in Manchester and Sheffield for working some of these deposits. If larger supplies could be obtained at a lower price, tungsten would be much more extensively used.

The Cotton Crop.—Mr. Hester's annual report on the cotton crop of 1906-7 has just been received. Mr. Hester says that it would have been the largest cotton crop ever grown but for the storms last autumn, which also had a considerable effect on the quality of the cotton. So exceptional was the weather during a part of the season that it appears that the average grade of the crop was low middling to middling, as compared with fully middling for the season before. On this basis, the crop sold at an average price of 10·29 cents. per pound, and Mr. Hester shows that the money value of this last crop is the largest ever received—716,352,265 dols.—although the yield of cotton was not quite equal to that of 1904-5, when the value was only 628,195,359 dols. With regard to the relation of the cotton grown to the commercial crop, Mr. Hester considers it certain that the past season saw a closer marketing than in the case of any of the preceding great crops. He makes the commercial crop, 13,510,980 bales, and the actual growth, 13,630,000 bales, so that the difference is only about 120,000 bales. The average weight of the bales is given as 515·02 lbs., or the heaviest on record, with the exception of the 1904-5 crop, which averaged 515·58 lbs., the inference being that the larger the crop the larger the bale. Mr. Hester gives many interesting statistics relating to consumption, and particularly to the progress made by the Southern mills. During the year there was an increase of 791,065 spindles in the mills, and the "new and not completed mills" which should soon be in operation, will add another 640,978 spindles. The labour difficulty is acute at present, and in Mr. Hester's opinion the South would have used another 200,000 bales of cotton last season if it had been fully manned. Yet the Southern takings were 2,439,108 bales as compared with 2,374,225 the previous season, and 2,163,505 the season before. "This year the facts," says Mr. Hester, "indicate more positively that the trend is clearer than ever in the direction of America eventually consuming her own cotton, to be sold to the world in manufactured form instead of as raw material, and the indications are further that most of this change will be brought about in sections almost immediately adjacent to the cotton fields." Fortunately for Lancashire the time is distant when this will be the case, and before then, it may be hoped, the British Empire will supply a much larger percentage of the British requirements than it does at present.

Wheat.—Not for many years has the British farmer been in such a favourable position as to his wheat as

now. The total wheat crop of the country promises to be considerably larger than the estimates of the summer, and the perfect weather of September has enabled it to be gathered in splendid condition. It is now thought likely that the crop will reach 6,750,000 qrs. as against 7,580,000 qrs. last year. And whilst the yield will be good, prices are much higher and are likely to go a good deal higher. Last year the price of wheat remained steady at from 28s. to 29s. during the first quarter of the year, and then rose slightly but steadily until the end of May when it remained at a little above 30s. until harvest. A fall of about 4s. then occurred, and the market remained at a level of about 26s. for the remainder of the year. Now it is over 38s., and prospective supplies fall very short of requirements. It is believed that the American surplus available for export will be less than last year. The present large exports of white wheat must soon come to an end, and it is doubtful whether any of the spring crop will be available for export beyond a moderate quantity of "durum," or macaroni wheat. The Canadian outlook is even less favourable. The Manitoba crop was sown very late, and had short time to ripen before the frosts came, the extent of which is said to be serious. And the short crops in America are not likely to be counterbalanced by good crops elsewhere. It is estimated that not more than 500,000 quarters per week will be forthcoming from other countries than the United States and Canada, while European countries require at least 1,200,000 quarters for seed. It is from Russia and the Danubian countries that the main supplies in the last three months of the year are usually obtained. Taking the last three years, more than half the total import has been from these countries in those months. Telegrams from Russia published last week spoke of the great prospective exports from that country, but the official estimate of this year's crops shows serious shrinkage. Comparing it with the final returns in 1905-6, in quarters and omitting 000's, the figures are as below:—

	1905. Qrs.	1906. Qrs.	1907. Qrs.
Winter wheat....	27,400	29,722	17,560
Spring wheat....	51,835	38,375	41,325
	79,235	68,097	58,885

So far as Russia is concerned the enhanced prices make up for the deficiency, but that does not help the British consumer. The Australian crop again is by no means assured, and there is no ground for supposing that the supplies from Argentina and India will show any great excess. In Berlin the price of wheat has already reached 50s. per quarter, and much higher quotations seem probable here. In France on the other hand, this year's wheat crop is about 3½ million quarters in excess of the annual consumption, and wheat is 10s. per quarter cheaper than in Germany.

GENERAL NOTES.

Riga Sawn Goods. — The effect of extreme competition is strikingly illustrated in Mr. Consul Woodhouse's report (Cd. 3283—176) on the trade and commerce of Riga for the year 1906, just issued. The great competitor of Riga whitewoods in the markets of the United Kingdom is Canadian spruce, but the demand of the United States for Canadian spruce has lately been very large, and prices have ruled so high that spruce shippers have been obtaining in the United States the equivalent of about £8 10s., £8 15s., c.i.f. London for 3 × 8 and 3 × 7 unsorted. Riga exporters seem to have ignored this fact. They commenced selling on a basis of from £8 to £7 15s., for the above dimensions, and "by their cut-throat" competition with one another, succeeded, by the month of April, in enabling the United Kingdom buyers to purchase from them at £7 6s. 3d. c.i.f., goods which they could not obtain elsewhere—that is, from Canada—under at least £8 10s. to £8 15s. c.i.f. Mr. Wodehouse explains this by saying that the Riga exporters of sawn goods are a badly organised body. They tackle more goods than they can comfortably finance. Their one idea seems to be to turn out as much stuff as they can, and get it shipped off before the winter comes, so as to have less stock to finance over during the closed time of winter. The result is that, through fear of not clearing their production of the summer and autumn before the winter comes, and easing themselves financially by getting their money back, they operate one against the other in making sales, and forcing the foreign markets.

Pastes in Italy.—Mr. Vice-Consul Carmichael directs attention in his report on the trade and commerce of Leghorn (Cd. 3727-3) to the increasing use of Italian pastes. At one time macaronis were a Neapolitan and South Italian article of consumption, and as such they are still regarded by many people not conversant with modern Italian developments. As a matter of fact, pastes are now as popular in the north of Italy (where rice formerly took their place), as in the south, while the improved condition of the agricultural and working classes, enables them to indulge more and more in this nutritious form of food to the exclusion of "polenta" rice and chestnuts. This development suggests to the Vice-Consul the question whether the manufacture of pastes might not profitably be extended to other countries. As food, it is agreeable, wholesome, and very nutritious, and by the expenditure of a few pence in meat for added condiments it can be transformed into a variety of savoury and appetising dishes. Mr. Vice-Consul Carmichael suggests that a general development of the use of freshly-made pastes might do much to solve the food problem among the poorer classes, giving the best possible nourishment at the lowest possible cost.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

EXAMINATIONS.

The programme for 1908 is now ready. The price of the Programme (containing the previous year's papers and the examiners' reports on the work done) is 3d. (post free 4d.) Copies can be had at this price on application to the Secretary, Society of Arts, Adelphi, W.C.

The examinations are now arranged under the following stages:—Stage I.—Elementary; Stage II.—Intermediate; Stage III.—Advanced.

The subjects include:—Book-keeping, Accounting and Banking, Shorthand, Typewriting, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages.

The Examinations will commence on Monday, April 6, 1908.

In the Advanced and Intermediate Stages First and Second-class Certificates will be granted in each subject.

In the Elementary Stage Certificates will be given in each of the subjects enumerated. These will be of one class only.

Certificates of proficiency will be granted in each grade to Candidates who pass in certain specified subjects during a given period.

In Rudiments of Music Higher and Elementary Certificates will be given; in Harmony Higher, Intermediate, and Elementary Certificates.

A fee of 2s. 6d. will be required by the Society from each Candidate in each subject in the Advanced and Intermediate Stages, and in the Elementary Stage a fee of 2s. for one subject, and 1s. for each additional subject taken up by the same candidate. The fees for Harmony and Rudiments nf Music are the same as for Stages II. and III.

Medals and Prizes are offered in each subject in Stages II. and III. Full particulars will be found in the programme.

Examinations are also held in the Practice of Music, and Vivâ Voce Examinations in French, German, Spanish, Portuguese, and Italian. For information as to these examinations reference should be made to the Programme.

"OWEN JONES" PRIZES FOR INDUSTRIAL DESIGN.

The Council of the Society of Arts hold a sum of £400, the balance of the subscriptions to the Owen Jones Memorial Fund, presented to them by the Memorial Committee, on condition of their spending the interest thereof in prizes to "Students of the Schools of Art who, in annual competition, produce the best designs for Household Furniture, Carpets, Wallpapers, and Hangings, Damasks, Chintzes, &c., regulated by the principles laid down by Owen Jones."

The prizes will be awarded on the results of the annual competition of the Board of Education, South Kensington. Competing designs must be marked, "In competition for the Owen Jones Prizes."

No candidate who has gained one of the above prizes can again take part in the competition.

The next award will be made in 1908, when six prizes are offered for competition, each prize to consist of a bound copy of "The Leading Principles in Composition of Ornament of Every Period," from the Grammar of Ornament, by Owen Jones, and the Society's Bronze Medal.

THE MECHANISM OF THE SOUTH-WEST MONSOON.*

By Sir George Birdwood.

Our terraqueous globe is wrapped in a layer of air about 40 miles high. This air is chiefly a mechanical mixture of nitrogen and oxygen gases, but it is also the recipient of all the volatile matters ever rising from the surface of the globe, and, among others, of the vapour of water in proportionally large quantity. The heat of the sun draws up the watery vapours from the seas and rivers, and so long as it remains in the state of vapour it is invisible; but on cooling it again takes palpable form, and falls to the earth from which it rose. It may be condensed and precipitated either by the greater cold of the higher spaces of the atmosphere into which it has ascended, or through being traversed by a colder current of air, or from its being whirled, with the revolving globe, away from the heat of the sun into the earth's cool shadow, we call the night. The cold of a clear night precipitates it as dew, or as hoar frost, which is frozen dew. A fog is caused by the condensation of the watery vapour in the air that rests directly on cold ground. A cloud is a fog high in the air, and snow is a frozen cloud which, as it congeals, descends. Rain is caused by the gathering together of many clouds, or aerial fogs. The sun cannot dissipate them, and their moisture gradually collects in drops, which fall as rain, Hail is a shower of rain, suddenly frozen as it falls. The heat of the sun also sets the atmosphere in motion, the winds which blow over the face of the earth being caused by the unequal heating of the air. When a fire is lighted, the air it heats ascends the chimney, carrying the smoke with it, and the vacuum caused in the air of the room draws to the hearth the colder outside air through every opening in the doors and windows; and when a city is on fire, so great is the vacuum caused by the upward draught of heated air, that the cooler surrounding air flows in to take its place as a violent wind; and so in accounts of great conflagrations we often read that the terror of the inhabitants was increased by the hurricane which blew at the same time. In such a fire it will be observed that the column of smoke from it does not go up for ever, but as it rises into the cooler air it spreads out on all sides like the branches of a palm, and gradually falls in "blacks" to the earth; and in this way bits of charred wood and paper are often brought back to a fire by the wind caused by it. Within the tropics the sun's rays fall vertically on the air, and its heated particles, constantly rising, form a column ever moving towards the poles. To fill the vacuum thus caused, colder air from the frozen poles rushes down over the surface of the globe towards the equator, and hence result the great polar and equatorial air currents, the direct courses of which between the poles and the equator are bent by the revolution of the earth on its axis, in the northern hemisphere into the North-East and in the southern hemisphere into the South-East "trade winds," or *vents alisées*, called "trade winds," not because they facilitate commerce, but because they hold a certain steady course, trend, or "tread" all round the earth. The air brought by the "trade winds" ascends to a great height in the tropics, and flows back towards the poles, in the northern hemisphere as the South-East "anti-trade," and in the southern as the North-East "anti-trade." The ascending air carries with it an immense volume of watery vapour, and as the air is quite calm on or near the equator, where the trade winds meet, this vapour, as soon as it reaches the upper atmosphere, is at once precipitated in the rains which fall within the tropics nearly all round the year. It is now proved that the Assyrians 3,000 years ago had anticipated Dr. Hunter's theory of the periodicity of sun spots, which implies that they also understood the theory of climate, as expressed in Ecclesiastes i. 6: "The wind goeth towards the south, and turneth about unto the north; it whirleth about continually, and the wind returneth again according to his circuits." Had the world remained, as it probably once was, a waste of waters, the trade winds would have blown over it, and all round the year, uninterruptedly, and the moisture in the air would have fallen on the earth in three continuous belts, one corresponding with the equator, and the others with the calms of Cancer and Capricorn; these calms would indeed have reached to the poles, and darkness covered the face of the deep. But the globe is divided between sea and land, and the land becomes hotter more quickly than the sea, as shown by the "sea breeze," that begins to blow about noonday in the tropics; and cools more quickly, as shown by the dangerous "land wind" which in tropical countries begins about midnight to blow over land toward the sea; and the consequence is that when the sun becomes vertical over any portion of the earth's land surface, it draws the surrounding air to a focus there; and in this way, in every latitude, the great primary winds and rains are broken into secondary, or local winds and rains, producing the differences in nature and season of the climates prevailing over the globe. Thus the manifold climates of the world are caused by the mutual relations of its atmosphere and sea and land; and all the changes of weather, shade and sunshine, heat and cold, calm and tempest, drought and rain, depend upon the movements the atmosphere is thrown into by the sun.

Owing to the excess of land in the northern hemisphere, the constant belt of rain where it exists between the trade winds, instead of corresponding with the equator, lies a little to its north, and the moisture gathered by the South-East trades only falls in rain when it reaches the tropic of Cancer, thus compensating the northern hemisphere for its want of evaporating (sea) surface. Similar modifications and compensations, on a smaller scale, occur in regard to each

* Monsoon = Arabic mausim "season," through the Portuguese monção. This article was originally contributed by Sir George Birdwood to *The Times*, and is reprinted here *en suite* of Mr. Brebner's article in the *Journal* of last week.

of the trades separately as the sun successively passes through the North and South ecliptic. But here we have only to consider "the Rains," or "South-West Monsoon" of Western India. India stretches out into the belt of the North-East trades, and were there undeviating winds the only rain this immense, outspread peninsula would receive would be that which falls from October to April during the North-East "Monsoon." The rain which then falls is not brought by this wind, for as it blows from the high lands of Eastern Asia, it bears with it but little watery vapour, except what it may lap up in the Bay of Bengal. But the great volume of rain falling on India during the North-East Monsoon, or winter rains, is really derived from the evaporation of the ocean about Australia, where during our winter months the sun is shining with all the force of mid-summer. The vapour there drawn up into the higher atmosphere returns in an upper current towards India, where it is precipitated through the lower current blowing from the north-east, and furnishes the North-East Monsoon rains, on which the Indian winter crops depend. If India depended on the North-East Monsoon rains alone, it would indeed be almost as unfortunately circumstanced as the peninsula of Arabia, wedged in between the high lands of Persia and Abyssinia. But observe what actually takes place. At the vernal equinox, March 21, the sun passes from the southern hemisphere to the northern; is first vertical over Bombay about May 15; reaches the highest point of his upward journey, or summer solstice, June 21; descending, is again vertical over Bombay about July 27; and finally, at the autumnal equinox, September 23, having traversed the whole tropic of Cancer, re-enters the tropic of Capricorn, reaches its lowest southern point, or winter solstice, December 23. Between May and July he shines down furiously on the sandy plains of Scinde and Rajputana, and the great grassy plains of Central Asia, from which so vast a column of heated air ascends up through the atmosphere that the draught caused has the power not only to reverse completely the normal direction of the North-East trade, but even to deflect and draw the South-East trade toward India. Thus is the South-West Monsoon brought about. This mighty wind, laden with the moisture gathered from the Indian Ocean, strikes the Malabar Coast and the Concans at nearly right angles, and there, chilled by the cool, green, forest barrier of the Ghats, pours down its condensed vapours on Western India for four months in violent rains, which are ushered in and depart with the most awful thunderstorms; and thus also it is that the temperature of India is lowered during months that otherwise would be so hot as to make the country unendurable. The Deccan slopes eastward, having been upheaved chiefly by the eruption of the Western Ghats, and the superfluous rain which falls on them, that does not flow off in the mountain torrents of the Concans, slowly drains off to the Bay of Bengal in such continental rivers as the Godavery, Cauvery, Pennair and Kistna. But the Ghats do not line the whole coast; they cease about Surat; and there the Sautpura and Vindya mountains condense the clouds borne by the South-West Monsoons, and pour their waters into the Arabian Sea by the flooded Tapti and Nerbudda, the only Deccan rivers flowing westward; while from the Aravalli hills in Rajputana, the Sabarmatti flows south-westward through the fertile plains of Gujerat. The South-West Monsoon reaches to the wide plain of Hindostan, the Punjab, and Scinde; and all round the coasts of India and Southern Asia, within the influence of the great solstitial up-draught from the deserts of Rajputana and Central Asia, we find the phenomenon of summer rains. At the very time, also, that the sun is drawing the vapours of the Indian Ocean towards the Western Ghats, his rays are melting the snows of the Himalaya and Hindu Kush, which flow down to the Arabian Sea and Bay of Bengal, in the perennial streams of the ancient Indus and sacred Ganges.

The mystic Saraswati, which once flowed through Rajputana to the sea, has long ages ago disappeared through the desiccating action of the summer solstice, or "standing still" of the sun over that country between May and July. The evaporating away of this river of Hindu poetry is a proof of how little unphilosophical political agitators take into account the play of natural climatic forces in India. We have traced the course of the sun through Cancer and Capricorn, and it will have been observed that he shines vertically twice as long over his "turning points" as over any other part of his ecliptic course. He appears to stand still over these points, which are hence named the summer and winter solstices; and so it happens that all the lands lying about the 23rd degree north and south of the equator, under these sun stations are desert lands. This is clearly seen in the northern hemisphere, where there is so much land, in the deserts of Rajputana, Scinde, Baluchistan, Persia, Arabia, in the Great Sahara of Africa, and the Tierra Caliente of Mexico. In the southern hemisphere there is very little land along the solstitial line, and what exists is surrounded by the widest oceans; but Central Australia is a desert, and the Kalahari desert stretches across South Africa, and the Pampas through South America. India is, in fact, one of the blast furnaces wherein the winds of the world are evolved, bearing with them everywhere fire and hail, snow and vapours, and the life-giving, purifying oxygen disengaged in ceaseless and immeasurable volumes from the perennially green primeval forests of the tropics. So placed at the very focus of her mightiest operations, man must stoop very humbly to Nature if he would hope to understand her and subdue her to his purposes; and this, through 3,000 years' experience, the patient, religious-minded Hindoo has learned to do; and it is certainly not for the farmers of our mild, equable climate to be too sure of being able to improve on Hindoo husbandry, or to insist too energetically on

the superiority of their own doctrines and methods. The real wonder is that India does not suffer more from agricultural distress and famines, and the reason of its comparative exemption from them lies in the phenomena of the South-West Monsoon. But most precarious, from a merely scientific point of view, is the yearly prospect of the seasons in India between the date of the solstitial hyperthermescence of the Rajputana desert and that of the storm of rain it calls up from the vasty deep. It always comes, but one might every year repeat the question, "Will it come?"—with the prayer, "God help its coming!" Any alteration in the condition of Rajputana by improved irrigation, or extended forest planting, or by an increase of its desert area, might produce incalculable results of the most disastrous character. The destiny of India seems, in fact, to hang in the balance between this desert country and the deep sea. The Hindoos themselves have always been devoutly alive to those solar influences and atmospheric phenomena that so intimately affect their prosperity and happiness as an essentially agricultural people. The gods of the earlier Vedic Hindoos are but the vaguest impersonations of the heat and cold, rain and drought, whose effects on their crops and herds were at once felt; and in the mythography of the later Brahminical Hindoos the first place was still given to Agni or Fire ["ignis"], and to Surya, the "shining" Sun, and to Vayu, the "vague," "vagrant," "vagabond" Wind, or to "domineering" Indra, the "atmospheric" Firmament [dome]. They together were pre-eminently the gods over all the gods of the earlier Brahminical "symmistry," or "college of gods," foreshadowing the Tri-murti or "tri-form" supreme divinity [Brahma, Siva, and Vishnoo] of the finally constituted pantheon of the Puranic Hindoos.

THE FOREIGN TRADE OF INDIA FOR THE YEAR 1906-7.

The grand total of Indian imports and exports combined was 317 crores of rupees in 1906-7, as against 292 crores in the previous year, the growth being one of 8·77 per cent. The increase was more pronounced in the case of imports than exports. Taking the trade by provinces, it is curious to observe that Bombay was the only province where the total value of merchandise received and exported actually showed a decline, the figures having been adversely affected apparently by the competition of Sind, where the value of the exports rose as high as 38 per cent.

IMPORTS.

In the group of articles of food and drink, the most important item is sugar, which represents 52 per cent. of the value of the whole group. The feature of the year was one of low, but fairly constant prices, the large shipments to India counting for a great deal in steadying the markets. On the whole, the imports of sugar very largely exceeded earlier records, both in quantity and value. The shipments of cane sugar exceed those of beet—close on 6 million cwt., as against less than 4 million cwt.—the premier place being occupied by Java, which in 1905-6 had ceded it to Austria-Hungary, a beet country, Mauritius being second. Under the somewhat comprehensive head of provisions, it is interesting to notice that there is a steady increase in the imports of foreign biscuits, and this in spite of the establishment of biscuit factories in India. This seems to indicate the acquisition of a new taste by the natives. As regards salt, there was, as in 1905-6, a small decrease in the quantity imported, this being attributed to the boycott of foreign goods. On the other hand, it is satisfactory to note that the successive reductions of the Indian salt duty have been accompanied by a growth in consumption. Liquors, *i.e.*, malt liquors, spirits and wines, have all declined both in quality and value, a result due, no doubt, to the competition of the breweries and distilleries now in full operation in many parts of the country.

Owing to a shortage in the Ceylon crop and in China shipments, and to a full crop in India, the imports of tea declined 29 per cent. in quantity and 12 per cent. in value.

In the important group of metals and manufacture of metals, interest attaches to the head of enamelled ironware, which now assumes for the second time the premier place, and the value of which during the year has actually increased 41 per cent. This is due partly to the high prices of copper and brass, and the extent to which domestic utensils of those metals have been replaced by German and Austrian ware marks an extraordinary change in immemorial habits throughout many thousands of native houses. Of this trade Germany now does 68 per cent., as against 54 per cent. in 1095-6, while Austria, which was supreme in it till two years ago, has receded from 42 per cent. to 23 per cent. Among minor heads lamp-ware and (to a less extent, of course) sewing machines show steady development. The share of the United Kingdom in hardware and cutlery declined from 68 to 65 per cent. in spite of an actual increase of 12·6 per cent. in the value of the trade, while Germany's share has risen to close on 16 per cent. of the value of the total consignments.

The prices of metals have been so high during 1906-7 that it is not surprising to find a diminution in the quantities imported. The enormous rise in the price of copper all over the world is due to activity in many industries, but mainly to the extended use of electricity. Brass, as well as copper, is used for household utensils, and this item increased 3·3 per cent. in quantity and 9·1 per cent. in value.

Iron and steel showed exceptional activity throughout the world in 1905-6, and this was still greater in 1906-7. The imports of the two metals into India were as follows:—

Year.	Iron. Rs.		Steel. Rs.		Total. Rs.
1905-6..	3,40,76,911	..	3,23,62,181	..	6,64,39,092
1906-7..	4,31,83,326	..	3,23,96,882	..	7,55,80,208

The arrivals of steel from the United Kingdom increased by 18·7 per cent., and now represent 63 per cent. of the total quantity imported, as compared with 54 per cent. in 1905-6. Her share in the total value rose from 61·5 per cent. to 70·53 per cent., or 5½ lakhs of rupees. In iron she increased her shipments to India by 19· per cent., and in steel by 12· per cent., while Germany and Belgium receded largely in both departments.

The most notable development in Great Britain's shipments occurred in galvanised sheets and plates, which increased over 26,000 tons in spite of a rise in price. In this class the Continent of Europe scarcely competes, but in plain sheets and plates Germany and Belgium did fairly well in 1906-7, and still better in the previous year.

There is probably no business in which combination has been carried further than in the iron and steel trade, and the past twelve months has seen fresh developments of this nature, details of which scarcely need review in these pages.

Lead, like all other metals with which the electrician concerns himself, has shown extraordinary price developments in the past two years, and the Indian consumption has declined to the extent of 28 per cent. in quantity and 16 per cent. in value, the average price having risen 17 per cent. Tin is associated with copper in certain industries now exceptionally active but of course to a much less extent. It is estimated that the production of tin in 1906 was about 98,000 tons and the consumption about 99,000 tons. About half of the production is derived from the Malay Peninsula and Archipelago and it is from this source that India derives most of her supply.

The steady increase of the imports of machinery is an indication of sound economic development. Bombay takes the first place among the Indian provinces, Bengal's receipts having declined 3·1 per cent. The totals of the various classes of machinery imported into India in the last two years have been (in thousands of rupees) :—

	1905-6. Rs.		1906-7. Rs.
Textile	2,48,98	..	2,27,45
Steam engines and parts.	1,00,33	..	1,31,13
Electrical	23,78	..	27,04
Mining	7,46	..	6,21
Other descriptions.. ..	1,12,00	..	1,88,05

In railway material, the progressive expansion in imports continues and the figures attained the highest level on record, *i.e.*, 849 lakhs of rupees, indicating an increase of 26 per cent.

In regard to chemicals and drugs the year under review was one of high value. Camphor in particular stands at the highest value known in thirty years, and although a synthetic camphor suitable for the celluloid industry has been produced in Germany and has given rise to an important Customs' dispute in the United States, it does not yet appear that a medicinal camphor can be artificially produced at a profit. The quinine trade has been extraordinarily dull, and 7d., the lowest price on record, held good for weeks.

As to the Indian tobacco industry, one of the few good auguries is the decline that has appeared for the first time in the importation of foreign cigarettes and the hardening of prices. On an average the consumption of cigarettes represents five per head of the population of British India, but the consumption of the imported article is still insignificant as compared with the consumption of the native *beri*. The imports of aniline and alizarine dyes improved slightly but the value declined. These products are mainly derived from Germany.

Oils.—The total value of all sources of oil imported in 1906-7 was Rs. 242 lakhs, or 8 per cent. more than in 1905-6. Of this total 80 per cent. represents kerosene. Excluding Burma's unascertainable internal consumption of indigenous oil, India in the last three years has absorbed some 110,000,000 of gallons of kerosene per annum, and it is known that its use is spreading. Russia, which in 1904-5 supplied 53 per cent. of the imported kerosene, now furnishes only 4½ per cent., owing to disturbed conditions in the productive regions, and the damage is so great that it cannot well be quickly repaired. On the other hand, the United States, which in 1904-5 supplied less than 10 per cent. of the total, now sends 54 per cent., while Sumatra holds the second place.

The increase in the imports of foreign coal reflects at once the activity of India's industries and railways during the year, and the large expansion that took place in coal movements throughout the world. For many years there has been a general tendency in India to substitute country coal for the imported article, but two years ago there was a recovery, and again in the year under review there has been an increase of 43 per cent. in quantity and 54 per cent. in value. The net increase is more than accounted for by the additional consignments from the United Kingdom. Imports of raw silks and raw cottons show diminution as compared with 1905-6.

Coming to manufactured articles, the imports of cotton goods in 1906-7 were restricted as a result of various influences operating simultaneously. These were—(*a*) the high level of prices; (*b*) the dearness of food grains and the consequent contraction of the people's purchasing power; and (*c*) the movement for the preference of indigenous products. The firmness of the world's market for British cotton goods is shown by the fact that enormous as was the exportation from the United Kingdom in 1905 it was largely exceeded in 1906, and this although India took something like one million sterling's worth less. The Swadeshi movement, or boycotting of English goods, counted for something in connection with this general contraction, but very much less than the other factors mentioned.

In yarns the decrease was one of over 8,000,000 lbs. or 17·8 per cent. in quantity and 5·9 per cent. in value. No less than 93½ per cent. of these come from the United Kingdom.

The imports of cotton fabrics represent 34·8 per cent. of the total imports of private merchandise against 37·9 per cent. in 1905 6. The value decreased to the extent of 3·39 per cent. A detailed analysis of the imports would be too technical for these pages, but it is interesting to note that the United Kingdom supplies 99·3 per cent. of the grey goods, 98·25 per cent. of the bleached goods, and 95·4 per cent. of the coloured goods imported. All these percentages are better than those shown in 1905-6.

The decline in imports of silk goods, which appeared in 1905-6, has continued in the following years. In woollen goods, as in several other products, the year 1906-7 will be remembered as a time of high prices and contraction of imports. Also under the head of apparel, which includes boots and shoes, there was a falling off of 4·7 per cent. Among the other miscellaneous items which go to make up the head of "Other manufactured goods" mention may be made of carriages and carts, which increased 20½ per cent., and which includes motor-cars and motor-cycles.

Viewing the imports *en masse*, it is interesting to note that the chief articles according to value are cotton manufactures, sugar, iron and steel, machinery and mill work, railway material, hardware and cutlery, mineral oil, provisions, apparel, woollen manufactures, silk manufactures and spices, all in the order named.

With regard to the country of origin whence the goods come, the United Kingdom of course stands far and away ahead of all others. The percentage of goods, according to value, was 66·3 in 1902-3, and 66·8 in 1906-7. Germany comes second, *longo intervallo*, but her percentage has progressed materially from 2·7 for 1902-3 up to 5·3 in 1906 7. The third place is now held by Belgium, whose percentage was 3·9 five years ago, and is now 4·0. It is probable, however, that when the improved system of record comes into operation a good deal of what is now registered as Belgian will have to be credited to Germany.

Exports.

The general development of direct communication between various parts of the world tends to diminish the trade of *entrepôts*, and the decline in India's re-exports in 1906-7 amounted to a little over 1 per cent.

The value of Indian merchandise exported in 1906-7 was 173 crores of rupees, as against 158 crores in the previous year, the increase being thus one of 9·4 per cent. These exports consist mainly of raw agricultural produce which increase in good seasons and diminish in times of shortage. But other causes operate of course and sometimes the reduced export of food grains may result from smaller production or larger internal consumption.

Among articles of food and drink (which altogether exhibited a net decline of 2 crores of rupees in value), Indian coffee makes a bad show, the exports having declined 36 per cent. in quantity and 43 per cent. in value. In the rice trade the most salient features were the strong internal demand, high prices, the large shipments from Burma to India proper, and the substantial diminution (10 per cent. in quantity) of exports to foreign countries. On the average of the last five years the value of the wheat exported represented 32¾ per cent. of the exports of all food grains, and 5¼ per cent. of the total value of Indian merchandise exported. As the supplies of one year are derived from the crop of the previous year, and there was much drought and hail in 1905-6, the exports of the year under review fell short, and were only 85½ per cent. in quantity and a shade less in value of the previous year.

In 1904 India was the largest contributor to the wheat supply of the United Kingdom, but in 1906 it fell back into fourth place, being below the United States, Russia, and Argentina. The only other considerable purchaser of Indian wheat in the year under review was Belgium, but she took only 70 per cent. of her share in 1905-6, while France also reduced her takings. The shortage of wheat and continued high prices necessarily restricted the exports of wheat flour. The exports go mainly to Aden, Arabia, Mauritius, East Africa, the Straits Settlements, and Ceylon. It is unfortunate that Indian millers should have been incapacitated from competing for a share in the abnormal Chinese demand of recent months by which certain of their rivals have profited considerably. Food grains other than rice and wheat declined in the aggregate by 28 per cent.

For tea the year under review has on the whole been the most prosperous on record. The reduction of the British duty to fivepence and the increase in the Russian demand helped to sustain the market, and the demand was stimulated by a contraction of some 3,000,000 lbs. in Ceylon's production as a consequence of unfavourable weather and by a shortage in China shipments. The area and production of tea in India have both increased for many years, but the latter has developed much more rapidly than the former. Since 1902 the increase of the former has been 1 per cent., but the production is believed to have increased by over 26 per cent. It is interesting to note that the joint stock capital engaged in the industry amounts to over 14½ million pounds sterling, more than 12¼ million pounds of this belonging to companies registered in London. This gives an average joint stock capital of £27 per acre, but of course takes no account of private capital invested therein.

The quantity and price of tea exported in 1906-7 constituted a record, the increase being over 9 per cent. in the former and 11½ per cent. in the latter. The United Kingdom took only 5½ per cent. more

than in the previous year, her share being relatively on the decline. Canada came next, and Russia (whose share expanded largely) third, Australia being fourth.

One of the most curious features of the exports of Indian metals and manufactures is the well-known output of manganese ore, which represents 77½ per cent. of the total increased value of the head referred to. This abnormal activity is due to the continued restriction of the Russian output of the ore, while the added facts that the greater part of the exports from India is superior in quality to the Caucasian product, and the exceptional activity in the steel industry during the past twelve months, have altogether rendered the business extraordinarily profitable, the shipments being mainly to the United States and Belgium in the order named.

The opium trade during the latter part of the year 1906-7 was largely influenced by the proposals of the Chinese Government for its ultimate abolition and for the early doubling of the import duty. The export of Malwa opium to China has been declining continuously from 35,000 chests in the later eighties to 12,991 in 1906. But so far as the comparison of the whole trade for 1906-7 with that of the preceding year is concerned, there was a net increase of 3,338 chests, due to the enlarged shipments from Bengal.

The trade in Indian tobacco, unmanufactured and manufactured, is feeling very severely both at home and abroad the competition of America, both as a grower and as a maker of cigarettes, and of certain European countries as producers of cigars. Nevertheless the shipments of the unmanufactured product grew by 60 per cent. in quantity and 46 in value, while the manufactured increased 14 per cent. with a decline in specific value of 1·4 per cent. The largest quantities of Indian cigars are taken by the Straits Settlements, the United Kingdom, and Gibraltar.

The year 1906-7 brought some encouragement to indigo planters, for the results obtained from the Java-Natal seed have left no doubt as to its superiority, and a larger area was sown with it for the current season. The declines have been in ten years nearly 80 per cent. in quantity, and 62 per cent. in value. In 1906-7, however, there was a recovery of 12½ per cent. in quantity, and of 19½ per cent. in value.

Oils (animal, essential, mineral, and vegetable) showed in 1906-7 a further decline of 14½ per cent., the greatest falling off being in mineral oils. Vegetable oils have also receded by 13⅝ per cent., almost the same percentage as gauged their fall in the previous year.

The exports of coal from India have developed enormously since 1885. In 20 years the average exports have grown from 16,524 tons to 576,278 tons per annum. In 1906-7 they attained 940,054 tons with a value of 76 lakhs of rupees, which means an advance of 12·28 per cent. in quantity and 15·75 per cent. in value on the exports in 1905-6. Among foreign buyers of Indian coal, Ceylon retains the first place, the Straits Settlements and East Africa coming next. India still takes some 250,000 tons of coal and coke from abroad, but the use of Indian coal in the power-use industries of the country is nevertheless almost universal.

The exports of raw cotton represent 26·94 per cent. of the whole value of Indian raw materials exported. The trade is governed primarily by Indian crop results, and secondarily by the relation of textile activity in Europe and the United States to the supplies available in America and Egypt. In these respects the season of 1906-7 was extraordinarily favourable. Prices were somewhat higher than in 1905-6, and although the margin of profit was perhaps less than in that year, the textile trade throughout the world—with the exception of Russia—was remarkably active. So far as the export from India was concerned there was only a slight, practically negligible, increase in quantity accompanied by an increase of nearly 3 per cent. in specific value. The countries whither the cotton is exported are Japan, Germany, Belgium, Italy, Austria-Hungary, and the United Kingdom, in the order named.

The exports of raw hides and skins represent in value 6·3 per cent. of the entire exports of Indian produce. The strong demand for raw hides which was noticed in last year's review continued in 1906-7, and then rose by 15·6 per cent., and by 22·46 per cent. in value. The exports of raw skins decreased by 13·78 per cent. in quantity and 7·74 in value.

In regard to jute, the year under review has been one of extraordinary activity and unprecedented profits. Raw jute now represents 32·92 per cent. of the total value of Indian raw produce exported, but the increase of percentage is due in part to a decline in the exports of certain other classes. The world's consumption of raw jute is believed to be about 29·3 million cwts., and India retains a virtual monopoly of the article, her out-turn in 1906-7 being 31¾ million cwts., indicating a steady and material increase during the last few years. The average value in the year under review was 16·81 rupees per cwt., being nearly double what it was in 1902.

Seeds represent nearly 16 per cent. of the entire exports of raw produce, and in the year under review they increased 12·26 per cent. in value and about 9·3 per cent. in specific value. The various items are linseed, rape, cotton, sesamum, ground nuts, castor and poppy, and France, the United Kingdom, Germany and Belgium are the largest buyers.

In silk there has been a marked rise of price everywhere, ascribed to improved consumption, combined with a shortage of two million kilos in the 1905 crop. The exports of raw silk from India increased 9·2 per cent. in quantity and 21·7 per cent. in value: in reeled mulberry silk there was an all-round drop of 10 per cent. in specific value, arising largely from the inferiority of shipments from Bombay.

The unprecedented activity of shipbuilding in 1906-7 and the dearness of possible substitutes

caused a further rise in the values of teak. Exports decreased through greater internal demand.

The world's wool markets have been strong throughout the year, with a gradual and unwavering increase in price exceeded only in 1882, when the average price was £17 10s. The exports from India, in 1906-7, were nearly twice as much as in 1882; they rose 8 per cent. in quantity, constituting a progressive record for the fourth year in succession.

Among articles manufactured and partly manufactured, the most noticeable feature is the decline in the export of cotton yarns and goods, which amounted to 225 lakhs (£1½ millions). In cloth a decline was to be expected as a consequence of the Swadeshi movement, while the Chinese demand for yarn was paralysed by the famine in that country, and the figures in the Straits Settlements reflected the general conditions in the Far East. On the other hand, the trade with the Levant has responded in an encouraging way to certain renewed efforts made in that direction in recent months.

The number of cotton mills at work in British India on the 31st March, 1907, was 210, of which 172 were joint stock concerns with a capital of £723,274, and 12·8 crores of rupees, or over 9¼ million pounds sterling. During the year 1906-7 there were registered ten new textile concerns with a nominal capital of 95·15 lakhs of rupees, and new capital to the extent of £372,079 in all was raised by existing companies. The additions of plant in the same year amounted to 250,790 spindles and 7,186 looms, by far the largest proportion of these being in Bombay.

The exports of jute manufactures in the three years ending 1905-6, represented 34·57 per cent., or more than one-third of the total exports of Indian manufactured articles. In 1906-7, the percentage rose to 41·53. The diminished exports of wheat became more marked than in the preceding year, and there was less activity in other articles of export for which bags are required. Nevertheless, the installation of fresh jute-spinning machinery continues, and the percentage of increase in spindles was 8·46, and in that of looms 9·56. The total value of jute bags and cloth has increased from 871 lakhs of rupees in 1901-2, to 1,571 lakhs in 1906-7. The largest buyer of Indian jute fabrics is the United States, which, because of her heavy import duty on made bags, takes her supplies mainly as cloth. In 1906-7, however, she took bags to the value of 48 lakhs of rupees, as compared with 16·21 lakhs in the previous year, an increase of about 200 per cent. The largest single buyer of bags is Australia, which increased her demand by 11·8 per cent., while the growth of nearly 50 per cent. in the exports to the United Kingdom is satisfactory, considering she also largely augmented her demand for cloth. Silk manufacture continues to decline; the scattered and unorganised condition of the silk industry, however, prevents its commanding attention commercially, and efforts are being made to develop it on the lines of co-operation between the weavers. Exports of woollen manufactures increased by 10·48 per cent. in 1906-7, carpets and rugs forming by far the most important part.

The continued activity in the leather trade of the world has led to a further marked increase in the quantity of tanned hides and skins, and to a further considerable rise in the average values. In the former the advance was one of 8·85 per cent. in quantity and 11·73 per cent. in value, with an enhancement of the specific value by 2·65 per cent., in addition to 14·6 per cent. in the previous year, and 14 per cent. in 1904-5. In the case of tanned skins the exports increased by 8·33 per cent. in quantity and 28·96 per cent. in values. The United Kingdom takes the bulk of these goods, but it is known that there is a movement in America for repeal or reduction of the import duties into that country. Lac has risen continuously in recent years as a consequence of activity in the electrical industry and increased demand for high-class varnishes. The United States maintained and confirmed its leading position as a buyer of shellac and button lac.

Distribution of Trade.

With regard to the countries of destination of the Indian export trade, it is noteworthy that the United Kingdom, with 26·9 per cent., has slightly improved her position, but is still short of the percentage (37·1) of 1903-4. The feature of the table is the assumption by Germany of the second place, in consummation of the steady advance of the past years. China drops into third place (instead of second), and France now takes precedence of Japan.

Gold and Silver.

The net imports of gold which, as well-known to students of India's economic statistics was always (as well as those of silver) considerable, increased from 45·8 lakhs of rupees to 1,485½ lakhs (£9,904,000), which is the highest on record.

The imports of silver attained the unprecedented level of 2,604 lakhs of rupees, and there can be no doubt that the heavy demand for the metal which has attended the commercial development of the silver-using East is the prime factor in the rise of price recorded above. The exports increased but were far below the average, and the net imports, amounting to 2,400 lakhs rupees, largely exceeded the figures for any previous year.

Shipping.

While the net increase on the value of imports and exports of merchandise by sea amounted to 7·2 per cent. of the total for the previous year, there was an increase of 11·61 per cent. in the tonnage of shipping that entered and cleared from Indian ports. The average tonnage is constantly increasing as is well known, and is now 1,477, and for steamers only, 2,266. Taking the sailing ships alone, the average tonnage is only 90 tons, which indicates that the sailing vessels are only small native craft.

The entries from and clearances to the United Kingdom were 3,121,861 as against 3,140,281 tons in 1905-6, while those from and to British Possessions other than the United Kingdom increased from 4,784,555 to 5,650,916 tons. The increase was, therefore, over 2 per cent. in the case of the parent country, while the increase in the case of the dependencies was over 3 per cent.

FRONTIER OR LAND TRADE.

The bulk of India's foreign trade is and always must be sea borne, the value of the trade across the land frontiers of India being equal to only 5·14 per cent. of the other. The foreign land trade has, however, after steady progress attained fairly substantial dimensions, being now about 11¾ millions sterling.

THE ICE PROBLEM IN ENGINEERING WORK IN CANADA.*

In Canada the physicist has excellent opportunity to study on a grand scale the operation of the natural laws governing the formation of ice in the many forms met with in the large and often turbulent rivers. To the engineer the problem is more serious, for the development of the vast water powers of the country must include means for combating the ice troubles which arise each winter. The conditions which must be met during the winter months are sometimes very serious, when ice is forming rapidly, and ice-bridges, dams, and shoves may change the whole character of the levels and channels in a single night. Rivers are known to have been turned entirely out of their course to seek new channels during a winter of unusual severity, and in some instances the reversal of a rapid is of yearly occurrence. Nowhere can one witness a more wonderful sight of the delicate poising of the forces of Nature than in one of the Canadian rivers in winter. The steadiness of the temperature of the water throughout the ice season is a matter of great interest. It seldom varies more than a few thousandths of a degree from the freezing point even in the severest weather. This is true for rivers flowing too swiftly for surface ice to form, as well as for the quieter streams protected by an ice covering.

In general three varieties of ice are distinguished, and present characteristics brought about by their method of production. Surface or sheet ice forms over the surface of quiet lakes or rivers, and is helpful or not depending on the particular conditions. Spicular ice, or as it is called in Canada, frazil ice, is formed by surface agitation in the more turbulent rivers, and in waterfalls, and accumulates in great quantities in the quieter portions of the stream where it is carried by currents. It varies in size from thin plates to fine needle crystals depending on the degree of agitation of the water, and of all the forms of ice it gives the most trouble in hydraulic work. Anchor- or ground-ice is the most interesting form on account of the fact that it grows along the bed of a river which is not covered by a surface sheet. It is formed in two ways: by the cooling of the bottom by the radiation of heat during cold clear nights, and by the freezing of frazil-ice carried down by the currents of water when in a supercooled state. A bright sun has a great influence on the ice, and as soon as its rays are sufficiently high to penetrate to the bottom, the ice is detached and rises to the surface. In so doing it frequently brings up stones or boulders of considerable size to which it is attached.

A study of the temperature conditions in the water during the production of these forms of ice shows that the freezing is accompanied by a small temperature depression in the water, amounting to a few thousandths of a degree from the freezing point.* During severe cold weather the water is thus thrown into a slightly supercooled state, during which time the ice crystals grow rapidly by continued freezing, and give rise to the agglomerating stage, when they possess adhesive properties and form lumps and spongy masses. In this condition the ice is dreaded by power users, for it quickly adheres to the rack-bars and to the machinery of the wheel-gates and turbines. In a short time it interferes with the operation of the wheels, and may at any moment cause a temporary cessation of operations. Fortunately, it is only a minute temperature depression which brings about these conditions, and methods of artificial heat applied about the affected spots relieve the situation in a short time. An intelligent use of artificial heat, specially at night time when supercooling is most common, is found valuable in preventing any interference with the normal operation of a power house. It is not necessary to warm the entire volume of water passing through, which would be very costly and difficult, but by applying the heat in the racks or wheel cases, or blowing steam about the affected parts, the ice is prevented from obtaining a foothold. The ice is as effective as so much water in producing a head, hence the necessity of passing it through, and never allowing it to freeze to the metal surfaces of the machinery. It is safe to say that where it is possible to apply even a small quantity of heat directly to the machinery and racks, a condition of affairs may be done away with which for many years has been regarded as involving inevitable interruption to the continuous operation of a plant.

There are other causes at work, however, to interfere with the operation of power plants, which depend on the particular spot where a power-house is located. Rivers like the St. Lawrence at Montreal are subjected to winter floods, occasioned by the accumula-

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* Cases are known, however, where anchor-ice was formed by copious nocturnal radiation when the water was slightly above the freezing temperature.

tion of frazil- and disintegrated anchor-ice. Where-ever open water or a rapid occurs above a surface sheet of ice, large quantities of frazil-ice are carried under by the currents, and settle upwards in the quieter parts. Large hanging dams of spongy ice are thus produced, which so reduce the available waterway as to cause serious changes in levels. Sometimes the channels become blocked entirely, and then the water backs up sufficiently to clear the ice away and produce a shove. A tremendous upheaval results, and large masses of ice are piled on high for miles around, often doing much damage.

It is well known that the most effective prevention to the formation of both frazil- and anchor-ice is the protection afforded by a surface sheet of ice. If a power-house is located on a river normally frozen over, with no stretches of open water above, no ice troubles are experienced. When this is not possible, artificial intake canals are usually constructed, in which the water flows sufficiently slowly to freeze over. If the canal is fed from the open river, booms and crib-work are resorted to in order to deflect much of the ice. If the inflowing water current is sufficiently rapid to draw the frazil under the surface ice, it is often necessary to cut artificial channels to allow of sufficient water for the wheels. Thus a surface sheet may prove to be disadvantageous. So many and varied are the conditions to be met with in the location of a power-house that no set of rules can be given to meet the general case. It is only by a thorough knowledge of the laws underlying the formation of ice that means may be found to cope with any particular situation. It may safely be said, however, that the ice problem in Canada is no bar to the future development of her vast water powers.

THE HEATING OF COTTON-CAKE AND ITS PREVENTION.*

Oil-cake made from cotton-seed is apt to heat under certain conditions. It is the experience of oil crushers at home that cake made from Indian cotton seed is peculiarly liable to this accident. Recent advices show that the evil is being mitigated by improved practice in the manufacture and storage of the cake; but large holders in Europe recognise that there is a certain risk in keeping heavy stocks under ordinary conditions in summer time. This, being true of temperate climates, is doubly true of those that are tropical or subtropical, and where the air is humid. In some dry parts of India it is stated that the danger has practically not been experienced, but in other parts it is well known. It would be increased by the conditions of storage in the close hold of a ship

On the other hand, the virtues of cotton-cake as a cattle feed are as yet little recognised in India; and, although the direct use of oil-cakes as manure is increasing in this country, such direct use is wasteful. The best results are obtained in other countries by feeding the cake to cattle, and employing the dung as a "fertiliser." This practice applies mainly to the feeding of fat stock under conditions not commonly encountered in India, and it is uncertain how far it could be adapted to the circumstances existing here. At present, therefore, it is impossible to postulate such an internal demand as would take off all the cake to be produced by a considerable cotton-oil industry in this country. But an oil mill of the ordinary kind relies on the cake for a very great part of its receipts. Without adequate receipts on this account, it is improbable that such a mill could be profitable; and for this reason anything that prevents the shipment of surplus stock to external markets is a serious matter.

It is thus clear that at the present juncture, one o the most important practical problems connected with a cotton-oil industry in India is the prevention of heating. There is no doubt that the heating is due to bacterial action or fermentation. But we know that the interior of a seed is free from such bacteria; otherwise it could not live and germinate as a seed. Therefore the bacteria must be in or rather on the husk or shell of the seed. This is borne out by the statement that decorticated American seed yields a cake more immune than is obtained from undecorticated seed. The removal of the husk apparently entails removal of the chief source of contamination. It does not, however, eliminate all risk; for in the process of decortication the machinery must become contaminated by contact with the husks and communicate the germs to the kernels as they pass to the mills.

There is in the United Kingdom no plant for the decortication of Indian cotton-seed. It is, therefore, impossible to say what truth there is in the suggestion that decortication becomes more difficult by the lapse of time between picking and treatment. In America it is the practice to decorticate as soon as possible. But even if decortication were successfully and generally carried out in India, the fact of the contamination of the kernel by contact with the machinery forbids any hope that heating could by this means be really prevented. It need scarcely be added that all analogy shows that in India the fermentation would occur much more rapidly and intensely than at home Therefore, whether the husk is to be left in the cake, or to be brought in contact with machinery that will afterwards contaminate the kernels, it is evident that this husk ought to be sterilised at the outset.

It might be possible to use some kind of antiseptic if the seeds were free of fluff or lint; but we are confronted by the fact that the fluff on Indian seed is abundant and peculiarly tenacious. In view of this fact there can be no doubt that the danger of tainting the oil or rendering the cake unpalatable to cattle by the use of an antiseptic, is greatly increased by the quantity of absorptive and retentive fluff that covers the seeds.

* From the *Indian Trade Journal* (the organ of the Indian Commercial Intelligence Department, Calcutta).

This fluff has hitherto constituted the most commonly recognised objection to Indian cotton-seed, both from the crusher's and from the feeder's points of view. And although it is evident that the most intelligent feeders at home have now recognised that its evils have been absurdly exaggerated, certain authorities continue to reiterate their criticisms on that score. It would, therefore, be desirable that the process to be employed for external sterilisation of the seed should be such as will remove the fluff.

Heat is probably the best agent for destroying bacteria. But to expose an oil seed containing albuminoids and other sensitive bodies to a high temperature for any length of time would be injurious. Fortunately the husk is a good non-conductor, and it is, therefore, open to us to consider whether sterilisation might not be accomplished by a brief exposure of the seed to the temperature of combustion, followed by subjection to conditions rapidly carrying off the heat acquired in the process.

The fluff on Indian cotton-seed is so inflammable that under certain conditions it can be made to burn almost explosively. It seems possible, therefore, that it might be ignited and consumed in such a manner as to do exactly what is wanted. The proposal, in fact, is to sterilise the husk of Indian cotton-seed by the act of removing the fluff with a quick blast of fire, the fuel consisting mainly of the fluff itself.

The apparatus would probably consist of a shaft of suitable height, into the head of which the seed would be admitted sparsely from a closed hopper. Near the head of this shaft, and on one or more sides of it, there would be a passage or passages leading to the outer air, or to a stiveroom. In the shaft, an upward current of air of a suitable velocity would be maintained, either by an aspirator in the passage leading to the stiveroom, or possibly by the combustion of the fluff within the shaft. Opposite to, or slightly below this passage there would be an arrangement for projecting into the shaft a blast of smokeless flame. Below this again the shaft would contain baffles or other appliances for the friction of the seed after scorching. The intention is that the seed, in falling down the shaft, should encounter an upward or transverse current of air of such velocity as would carry off loose dust, lint, and other impurities of a light character. It is probable that seeds to which a very large quantity of fluff or lint adhered would also be drawn out at this point. The seeds that remained would in their further descent come in contact with the blast of flame, and would by the upward current of air be retarded in their passage through that flame, for a moment proportionate to the greater or less quantity of fluff adhering to them. The air current would rapidly carry off the products of the combustion which would probably be fierce. As soon as a seed became free of lint, and so offered a diminished resistance to the ascending air-current, it would drop out of the focus and continue to fall through air at a natural temperature. The air at this point might be dry, and this would facilitate the complete combustion of any lint that might still adhere to individual seeds. At the same time all dust and ash would be carried off, and the seed would be partly cooled. At the head of that section of the shaft which is furnished with baffles it would probably be well to admit part of the air furnishing the upward current. The air admitted at this point might, as we say, be dry. The effect of the admission of air at this point would be that below it the current would have less velocity, with the result that gravitation would make the seed impinge upon the baffles with such force as to knock off any traces of ash. It might be found expedient that the air admitted at the base of the shaft should be humid, in order to expedite the cooling of the seed.

In effect, the seed ought to reach the foot of the shaft cool, free from fluff, and sterile. It is improbable that anything would be gained by decorticating such seed; but in any case neither the decorticating plant, nor the ordinary crushing plant could acquire germs from a sterile husk, and it follows that the cake made from seed so treated would probably not heat.

This general idea is published in the hope that some firm interested in appliances for the crushing of cotton-seed may be induced to test the practicability of the process.

THE SURVEYS OF BRITISH AFRICA.*

It is perhaps not generally known that during recent years a good deal has been done to ensure the systematic mapping of British Africa. There are at the present moment properly organised survey departments in the Anglo-Egyptian Sudan, Uganda, East Africa, Southern Nigeria, and the Gold Coast. In addition, an exact topographical survey is in progress in the Orange River Colony; and in the Cape Cape Colony a military reconnaissance survey has been at work for two and a half years. The annual cost of the surveys above enumerated amounts to some £80,000. An account of the progress made, the scales adopted, and the history of the surveys will be found in a Colonial Office Annual Report, No. 500, entitled the "Surveys of British Africa." Unfortunately, official reports have a limited circulation and public departments cannot very well advertise their achievements. As a consequence, all this systematic work, which produces surveys of a permanently valuable character, is largely unknown to the geographical world. It is clearly desirable that that section of the public which takes an interest in the matter should be informed as to the steps which are being taken to map and explore British Africa, which, it may be noted parenthetically, covers an area of about 2,690,000 square miles. During the current year about 45,000 square miles will have been topographically surveyed, and to this must be added a large

* Abstract of paper read by Major C. F. Close, R.E., before Section E of the British Association, at Leicester.

number of compilations, the surveys of boundary commissions, and cadastral surveys. The maps are put on sale as they are published, and can be purchased from the usual map sellers and agents. Anyone desiring special information on the subject is advised to write to the Secretary, Colonial Survey Committee, Colonial Office.

NICOTINELESS TOBACCO.

What is popularly known as "Caporal doux," or the so-called "nicotineless tobacco," in France, is simply ordinary caporal tobacco which has been treated by washing with water until the ordinary proportion of 2½ per cent. of nicotine has been reduced to 1 per cent. In this form it is used for smoking in pipes and for the manufacture of cigarettes, which find a certain favour among smokers who prefer a light flavour, or who by reason of nervous or cardiac weakness are wary of nicotine. Ordinary caporal is a mixture of French, American, and Oriental tobaccos, prepared by the Régie or Government establishments, which have a monopoly of the manufacture of tobacco, cigars, and cigarettes in France. It has a somewhat rank, but not unpleasant flavour, and is the cheapest and most popular form of tobacco used in France. The American Consul-General in Paris says that about eight months ago the French Government, finding that there was a growing demand for a so-called "nicotineless tobacco," which had been made on a small scale by certain druggists, and was also manufactured in Belgium, began the manufacture of a similar product by denicotinising caporal tobacco through the action of water, which, in reducing the proportion of nicotine from 2½ to 1 per cent., also washes out other ingredients, so that the weight of the tobacco is reduced, according to the quality of the leaf, from 15 to 30 per cent. It is this loss of weight rather than the actual expense of the process which constitutes the cost of denicotinising, and explains the fact that ordinary caporal tobacco is advanced so much in value when denicotinised. The process of washing is simple, and is facilitated by the use of automatic machinery, but it requires careful and constant supervision by a skilled and trustworthy workman, in order that a uniform product containing the specified percentage of nicotine may be obtained. It is too soon to form any conclusion as to the extent to which denicotinised tobacco and cigarettes may be used in France. It is now on sale in Paris and in eighty other municipalities throughout the country. During the four months from January 1st to April 30th last, there were sold by the Régie to dealers in Paris 26 tons of denicotinised tobacco, and 5 tons, or 50,000,000 cigarettes, made from the same material. To smokers accustomed to full-flavoured tobacco the smoke of "caporal doux" is somewhat insipid. Its one advantage is that 25 cigarettes made of it contain only the same amount of nicotine as 10 of ordinary "caporal," and its narcotic action upon the heart and nervous system is proportionately reduced.

HOME INDUSTRIES.

Enterprise in Agriculture.—*The Times* of October 5 contained, under the heading "An Agricultural Success," a most interesting contribution from a correspondent, who describes what has been done in recent years by Mr. A. J. Keeble, of Wereham-hall, Norfolk, in reclaiming practically waste land. Mr. Keeble had done a good deal in this way before he went to Stoke Ferry. In one case he had dealt with some 687 acres, which he divided into sixteen lots, and in another with 3,780, divided into 191 lots. His operations on these two estates yielded him a profit, out of which to a large extent he was able to acquire his Norfolk residence without trenching on original capital, and it is with these freeholds that the correspondent referred to above concerns himself. The estate is 12,771 acres, or about 20 square miles. The land was practically derelict when Mr. Keeble took it over. A large portion of it, which be bought from the Duchy of Lancaster at £2 17s. 6d. per acre, was absolutely so. Wissington-hall, which he made his home before he acquired Wereham, was derelict. "Saverals," a farm of sufficient importance to be marked even on the smaller maps, was derelict too. To-day these 12,771 acres are in the occupation of 48 farmers, whose average holding is 255 acres. Mr. Keeble's first care is to find what size holdings suits any given district, and, believing that men are the essentials, he does his utmost to make the holding for the man. Thus, a middle-aged farmer, with a couple of grown sons, will do best by tackling a larger area than another dependent on two hired men.

Mr. Keeble, on acquiring his properties south of the line from Downham to Stoke Ferry and north of the line from Ely to Brandon, saw that the cultivators of this district would be impotent if unable to find a proper outlet for their produce. He had acquired land at £2 17s. 6d. per acre freehold, strips at even less, and he had paid as much as £17 per acre for special land. But between these prices he had always found sellers, and he held a compact area suitable for development. To develop it required a private railway. Mr. Keeble built one. "The railway, between five and six miles in length, is not a light railway as that term is usually understood; its gauge is that of the Great Eastern, with which, at Abbey Station (short for Dereham Abbey) it connects; its trucks, therefore, run straight on, and when Mr. Keeble hires a special on the Great Eastern, he or his tenants, mostly, of course, their produce, travel 'through' from open fields in the heart of Norfolk to Liverpool-street or Stratford. The bridge over the Wissey is of strength and size which surprise the most casual glance. The constructor — for Mr. Keeble is his own engineer as he is his own architect —explains that he has made the whole line in such a manner that a Great Eastern train could run on it. The bridge will carry an express." The sidings of this unique private line are at quarter-mile intervals, and every farm on the estate debouches on to the

line. The Great Eastern Railway keep up high tariffs, but allow many facilities. "Thus, if the tenants of the Keeble estates can make up—as they frequently can—an amount of stuff for the London market amounting to 100 tons—say 20 medium or 25 small trucks—the company will send a special engine to fetch this train, and give the resulting "special train" prompt passage to London, where the produce can be, and is, on sale at 5 a.m. Mr. Keeble has a salesman at King's-cross, and another at Stratford (the goods station for Liverpool-street), whose services enable his tenants promptly to dispose of produce. All sales are telegraphed, and the local grower can have his cheque for the net result at any time he pleases. The private railway has a telephone running by the side of it, and at its terminus; at a wooded house, in fields somewhere between Southey and Feltwell, messages are received throughout the day. There is a time-table on this little line, not printed indeed, but painted on a notice board. The train has a passenger coach, and farm labourers are saved all walking. The saving of exertion and fatigue that free facility gives is beyond calculation, and the telephone prevents the remotest cottager from feeling isolated. In case of ill-health, or other emergency, communication is at hand, while 'the market intelligence, with prices made,' which is wired to Mr. Keeble, at Wereham, by the London salesmen, is telephoned along the private line. It often decides the day's work, still more frequently the next day's, for these Fenland cultivators do not neglect the markets.

The land is of course exceptional; the vigour, resourcefulness, and knowledge of its owner are of course exceptional; even Mr. Keeble could not have literally changed the face of the land as he has done without having large capital at his command. It is not every landowner whose soil would respond, as Mr. Keeble's does, to good treatment, or which is so favourably placed. But when all allowances are made for exceptional conditions, the results are very remarkable.

State Afforestation.—The Government have taken a step which has been warmly welcomed generally. They have bought the estate of Inverliver, in Argyllshire, from Colonel Malcolm, of Portalloch, in order to convert it into a State forest. The estate has an area of nearly 13,000 acres. At present there are only about 90 acres of plantations, and a long time must elapse before any new timber becomes saleable. But a certain number of acres will be planted every year; the estate will be a school of forestry managed by the Office of Woods and Forests, and it may be hoped that it will be the forerunner of other similar estates. In other European countries the State has done much afforestation to the general advantages, as, for example, in the West of Jutland, where the land is singularly barren, and there is general admission that there are large areas in the United Kingdom which might be profitably planted. But it is essentially a work to be taken in hand by the Government, if it is to be done at all on the necessary scale. Individual landowners will not make, or cannot afford, the large outlay required by afforestation, outlay for which only young men could expect to reap any financial return. But the State is not hampered by such considerations, and the contraction of foreign sources of supply of timber may well encourage statesmen to take the work of afforestation in hand.

"Chilled" Meat.—Last week the first consignment of "chilled" meat, as distinguished from "frozen" meat was landed at Liverpool in what is said to have been excellent condition. It came from Buenos Ayres, where it was killed 43 days previously. Until now, attempts to carry fresh meat long distances, except at very low temperature, have been unsuccessful. They have induced "spotting" and "mildew," but this does not seem to have been the case with the present consignment, although it was carried at a mean temperature of 31½ degrees Fahrenheit, or three degrees higher than has before been attempted. The ship which brought it, the steamer *Guadiana*, has a larger capacity for carrying refrigerated meat than any other vessel afloat, namely, a total of 180,000 carcases. She was built specially for the Argentine fresh meat trade, and is fitted with the ordinary brine circulating system. The chamber is fitted with the Linley process. The new system has been introduced to obviate the deterioration of the meat due to freezing.

The Wool Sales.—Both in Australia and in London the wool sales have begun well for the pasturalists. At the opening of the sales in Adelaide there was a large attendance of buyers, and practically the whole of the offerings, which covered 20,000 bales, were disposed of at prices showing an average advance, compared with last season, of 10 to 15 per cent., for all the better classes of greasy merinos, while lamb's-wool appreciated 10 per cent., and the finer grains of cross-breds fully 5 per cent. The quality and condition of the new clip are reported to be very satisfactory. The sheep have cut very big fleeces of deep-stapled sound wool. The London wool auctions are also animated with values much as it was expected they would be. The Queensland wools, both scoured and greasy, are just what the trade wants, and with keen competition prices are up 5 per cent., and in some cases more. A portion of one big clip, grown in Queensland, has sold at prices which will make it cost about 32d. in the top. Other Queensland clips of greasy wool have been taken by France at prices which, it is estimated, will cost over half-a-crown in the top, whilst the United States are purchasing wools which, when the duty has been paid, will cost at least a dollar in the same state. At Bradford, the market remains quiet, users being unwilling to anticipate their further wants. Having regard to the monetary and general commercial outlook, prudent traders may be expected to refrain from buying more than enough to meet present needs,

Delays in Transit.—Attention was recently directed in these notes to the loss sustained by Lancashire spinners, in common with other importers, from delays in transit on the American railways. A company working from Burnley, Lancashire, and Memphis, U.S.A., which has been recently formed to sell American cotton directly to Lancashire spinners, had 5,000 bales stored in Memphis, for three months last season, after the railway company had issued bills of lading. As might be expected, the condition of the bales on their arrival in this country, after exposure to the weather for so long, was bad. The company has now opened a new compress on the Mississippi, at Memphis, this compress being built in order to remedy the inconvenience and loss consequent upon railway delay, and this is done by avoiding the railway altogether, between Memphis and New Orleans. The intention is that cotton received at the compress shall be pressed and delivered into a barge on the same day. Four days later the barges will be alongside the steamers at New Orleans, and will be transhipped without being landed on the quay at all. It is expected that in this way the vexatious and costly delays of the past will be entirely avoided. The cotton will be constantly under cover, picking and mending will be obviated, and good condition should be ensured, with delivery within a month of shipment.

CORRESPONDENCE.

SWISS STRAW GOODS INDUSTRY.

Mr. W. L. A. Gautier writes respecting a statement in the article on "Straw Goods Industry" in the last number of the *Journal* (page 1060, col. 2, ll. 2 and 3):—"I have been engaged in the industry for over forty years, and I never heard of *straw* being knotted together for plaiting. The materials which require to be knotted into long lengths are hemp and horsehair only. The short lengths of *real straw* are spliced by the plaiters in the process of plaiting. The other two materials are plaited by machinery, hence splicing is impossible in the process of plaiting."

[The American Consul at Aarau makes the statement in his report, which is objected to by Mr. Gautier, and adds that the knotting is a work requiring infinite patience and considerable skill.—Ed.]

GENERAL NOTES.

School of Art Wood-carving.—The School of Art Wood-carving, South Kensington, which now occupies rooms on the top floor of the new building of the Royal School of Art Needlework in Exhibition Road, has been re-opened after the usual Summer vacation. Some of the free studentships maintained by means of funds granted to the school by the London County Council are vacant. The day classes are held from 10 till 1 and 2 till 5 on five days of the week, and from 10 till 1 on Saturdays. The evening class meets on three nights a week and on Saturday afternoons. Forms of application for the free studentships and any further particulars relating to the school may be obtained from the manager.

Damascus.—In his report upon the trade of Damascus (Cd. 3729) Mr. Consul Dewey refers to its population. At the last census, which took place in 1906, it was put at little more than 203,000 souls, but, owing to the irregularity with which the census was taken, the figures cannot be taken as accurate. It would be proper, in the opinion of the Consul, to say that the residents of Damascus are not less than 250,000, and some authorities rate them at over 300,000 souls. Only about one-eighth of this population are Christians or Jews, the remaining seven-eighths being Moslems. As in 1895 the population was estimated at 215,000, it would seem to be increasing somewhat rapidly, but this increase is entirely among the Moslems, and is greatly due to a large influx of emigrants from Crete, the Caucasus, the Balkans, &c. The Jewish element has remained stationary at about 8,000 or 10,000, and the Christians have diminished slightly by emigration through Beirut to various parts of the world.

British Trade with Belgium.—In the course of some remarks upon the trade of the United Kingdom with Belgium, to be found in his report upon the trade of that country for 1906 and the first half of 1907 (Cd. 3277-1), Consul-General Sir Cecil Hertslet observes that British firms endeavouring to sell their goods in Belgium in many cases obtain, through the medium of a Consular officer, or the Intelligence Branch of the Board of Trade, the names of likely buyers of their goods, with whom they communicate, and in many cases establish a fair trade. Only in exceptional cases, however, is it remembered that the foreign taste in regard to certain articles is not necessarily the same as the British. The advertising of British goods in Belgium is, of course, an excellent way of making them known; but in the case of firms in a fairly large way of business, there is no better way of making their goods known than by sending travellers to Belgium to show their goods to likely buyers and to impress the merits of the same upon them. These travellers should endeavour to find out the style of article required, and British firms should be prepared to make it of the particular model required if they wish to enlarge their trade. It is in this way that German firms obtain so large a share of Continental trade. The idea of "educating the foreigner to British tastes" is not, says Sir Cecil Hertslet, generally speaking, the way to encourage him to purchase British-made goods, though, of course, in certain cases it does so.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

FOTHERGILL PRIZE.

FOR LIFE-SAVING APPARATUS FOR USE IN NOXIOUS ATMOSPHERES.

The Council of the Society of Arts are prepared to award, under the Fothergill Trust, a Gold Medal, or a prize of £20, for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious.

It is intended that the apparatus sent in shall be submitted to practical trials and tests.

In the award of the Medal regard will be had, firstly, to excellence of design and contrivance, and, secondly, to excellence of manufacture. Credit will be given to such parts of the apparatus as are the invention of the exhibitor; the object being to distinguish the apparatus which gives the best promise of being practically useful.

Inventors intending to compete should send in a notice of their intention, together with a full description of their inventions, not later than 31st March, 1908, to the Secretary of the Society of Arts, John-street, Adelphi, London, W.C.; and in cases in which the apparatus has been put into actual use, the experience of such use should be given, and the special points of merit of the apparatus indicated.

Notice of the place to which the apparatus is to be sent will be subsequently given to those competitors whose apparatus the judges may desire to test, together with an indication of the tests, and of the manner in which they will be conducted.

Competitors intending to patent their inventions should be careful to obtain protection, as the Council of the Society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The Prize will be awarded on the report of judges appointed by the Council.

The competition is not limited to British subjects.

The Council reserve to themselves the right of withholding the Prize, of extending the time for sending in, or of awarding a smaller Prize or smaller Prizes.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

DETERGENTS AND BLEACHING AGENTS USED IN LAUNDRY WORK.

BY PROF. HERBERT JACKSON, F.I.C., F.C.S.

Lecture I.—Delivered April 15, 1907.

In these lectures it is intended to deal with the subject-matter mainly from a practical point of view. Such analytical processes as are described are those which are easy of application and which have been found to give results accurate enough for the special purposes they are meant to serve.

Water is undoubtedly the most important agent used in laundries, whether it is considered as a detergent itself, as a solvent for more powerful detergents, or in relation to its use in boilers. For washing purposes there is no question that pure water fulfils all the requirements most perfectly, but as it is never procurable in sufficient quantities it is necessary to determine how far the solids dissolved in the water supply render it unfit for laundry purposes. It is well known that salts of calcium and magnesium present to any great extent prevent the economical and useful application of soaps for reasons which will be considered shortly, but it must be remembered that large quantities of other soluble salts such for example as sodium chloride and sulphate,

not only retard the action of soap and prevent the removal of dirt in a fine state of division but are objectionable in boilers. In actual practice it was found much more economical, and to give better results, to change from a water containing 116 grains of solid matter to the gallon to one with 48 grains, although the latter was four times as hard from calcium salts and the expense of the softening had to be incurred. Another reason for discarding a water holding much solid matter in solution is to be found in the character of the residue left by the evaporation of the water. This is frequently found to be markedly deliquescent, and articles of clothing rinsed in the water absorb moisture from the air and become damp very soon after they have been dried. As a rule a water residue which readily takes up moisture will be found to contain some chlorides of magnesium and calcium.

In most waters which are met with in practice the common forms of calcium salts present are calcium bi-carbonate (*i.e.*, a solution of calcium carbonate in carbonic acid) and calcium sulphate. Their action on ordinary soaps consists in the production of insoluble calcium salts of the fatty acids of the soap, with the accompanying formation of soluble sodium bi-carbonate or sulphate. Expressed in the form of a chemical equation, and adopting sodium oleate as a typical simple soap, the reaction is:

$$CaCO_3 . H_2CO_3 + 2\ NaC_{18}H_{33}O_2 = Ca(C_{18}H_{33}O_2)_2 + 2\ NaHCO_3$$

and—

$$CaSO_4 + 2\ NaC_{18}H_{33}O_2 = Ca(C_{18}H_{33}O_2)_2 + Na_2SO_4.$$

A calculation from these equations shows that 100 parts of calcium carbonate or its equivalent of any other calcium salt dissolved in water, will convert 608 parts of pure sodium oleate into the useless form of insoluble calcium oleate. Substituting any good soap of average quality for the sodium oleate, 100 parts of calcium carbonate in solution would react on about 1,000 parts of the soap. As the gallon is still used as the standard measure of volume in many industries, it is convenient for the present purpose to retain the older form of expression, and to speak of one degree of hardness as that due to the presence of one grain of calcium carbonate or its equivalent of any other calcium salt in solution in one gallon of water. Every gallon of pure water requires about 10 grams of ordinary soap before a lather can be produced, and it will be seen from the numbers given above that each degree of hardness will necessitate the addition of another quantity of 10 grams of soap. The action of magnesium salts is similar in general character to that of calcium salts, but differs in respect of the amount of soap used up and in the time occupied for the completion of the reaction. The chemical equivalent of magnesium carbonate for 100 parts of calcium carbonate is 84, but it is found that this amount is equal in soap-destroying power to 150 parts of calcium carbonate, and this must be taken into account in estimating the hardness of waters containing appreciable amounts of magnesium salts. The question of the time of the reaction with soap is often of importance. Whereas calcium salts react immediately with soaps, the action of magnesium compounds is gradual, and may be delayed considerably. In one water which contained the equivalent of 8 grains of magnesium carbonate and 14 grains of calcium carbonate to the gallon, the hardness of the water towards soap was not shown as more than 18 degrees, even after the lapse of 48 hours. Dilution with an equal volume of distilled water hastened the action, but the total hardness of about 27 degrees was not revealed until the water was heated with the soap solution to 50° Cent. (122° Fahr.). It may be mentioned here that this anomalous action of magnesium salts is by no means so marked with pure sodium oleate as it is with soaps containing also sodium palmitate and stearate. Before dealing with processes for softening waters it is necessary to consider the nature of hardness somewhat more fully, and to describe simple methods of determining the degree of hardness in a water.

It is customary to draw a distinction between temporary and permanent hardness. The former is considered to be due to the presence of carbonates of calcium and magnesium, held in solution by carbonic acid, and is described as temporary since heating the water drives off the carbonic acid gas and precipitates the carbonates as insoluble granular or crystalline powders. The latter is due to any other salts of calcium and magnesium, such for example as chlorides or sulphates which are not thrown out of solution when the water is boiled. This distinction between two kinds of hardness is convenient for some purposes, but it is misleading in connection with the use of water in boilers. The statement that calcium sulphate is not thrown down on boiling under ordinary atmospheric pressure is practically true for a water containing somewhere about 10 grains of this compound per gallon along with varying

amounts of calcium carbonate. The deposit obtained from such a water by simple boiling will be found to contain mere traces of calcium sulphate. It is quite otherwise, however, when the water is heated under pressure in a boiler. In this case, the temperature rising above the ordinary boiling point will cause the separation of a considerable amount of calcium sulphate, which mixes with the deposited calcium carbonate, and forms a hard and intractable crust in the boiler. No distinction between temporary and permanent hardness need be made so far as the action on soap is concerned. Both the carbonate and other salts of calcium and magnesium act in a similar manner, and it is only therefore in connection with softening processes that the recognition of the two forms of hardness is useful.

The determination of hardness for laundry puposes is best carried out by the well-known process of treating a definite volume of the water to be tested with a soap solution the value of which has been ascertained by means of a solution of a calcium salt of known strength. In making up these solutions it is much more convenient to use metrical weights and measures. Any good and fairly dry olive oil soap, *e.g.*, Castile soap* will be found suitable, and 10 grams of it should be dissolved in a litre of alcohol of about 40 per cent. strength. The solution of calcium salt which is to be taken as a standard is easily made by dissolving one gram of pure calcium carbonate in as small a quantity as possible of dilute hydrochloric acid, adding a very slight excess of dilute ammonia to neutralise any free acid and making up the volume of liquid to one litre by adding distilled water. (In order to be able to translate results readily into grains per gallon it is best to adopt 70 cubic centimetres or some simple multiple of 70 as the quantity of water to work upon, since there are 70,000 grains in a gallon and 70,000 milligrams in 70 cubic centimetres). The valuation of the soap solution may be made by taking 10 cubic centimetres of the standard solution of calcium chloride and diluting it to 70 cubic centimetres with distilled water. This will represent a water of 11 degrees of hardness, the extra degree being for the water itself which requires soap equivalent to one milligram of calcium carbonate before a lather can be formed. If on adding soap solution from a vessel graduated in cubic centimetres and parts of cubic centimetres with constant shaking, a lather permanent for about five minutes is formed after 11 cubic centimetres of soap solution have been added to the 70 cubic centimetres of diluted standard calcium solution the soap solution is right, and the number of cubic centimetres of it used to form a lather with 70 cubic centimetres of any water will indicate the degrees of hardness in that water. Should the soap solution be found to be stronger or weaker than the standard, it may be diluted or strengthened to bring it right or used as it is, unless it is very far out, and a simple calculation made for correction of the results. With very hard waters it is necessary to dilute them with an equal volume of distilled water, and to take 70 cubic centimetres of the mixture before applying the soap test, due allowance for the dilution being made in calculating the hardness. The so-called temporary hardness of a water may be estimated with an accuracy sufficient for the purpose of guidance in determining the best softening process to be employed by boiling a known volume of the water for about half an hour. After cooling any loss by evaporation is made up with distilled water and 70 cubic centimetres of the filtered water are tested by the soap solution in the ordinary way.

The agents which may be considered to be available for softening processes in laundry practice are heat, lime, caustic soda, carbonate of soda, and mixtures of the last three. With regard to heating as a method of softening water, it is seldom that anything approaching to the amount of water required can be treated by the available sources of heat which would otherwise be wasted, and the direct application of heat is out of the question on the score of expense. Even when waste heat is obtainable in quantity the process is only applicable to water in which the hardness is mainly temporary. In general practice therefore one or more of the three substances mentioned must be adopted, and the principles of applying them should be understood in order to make sure of getting good results with economy.

Lime acts on water which is hard from the presence of calcium and magnesium carbonates dissolved in carbonic acid by combining with this acid to form insoluble calcium carbonate, which is precipitated along with the carbonates which were in solution since they are deprived of the carbonic acid which made them soluble. In this way a water which has only temporary hardness may be softened to a

* Pure sodium oleate is perhaps the best soap to use.

very great extent by adding to it lime either in the form of powdered slaked lime or of lime water. The action expressed in the form of a chemical equation is

$$CaCO_3\,H_2CO_3. + Ca\ (OH)_2 = 2\ CaCO_3 + 2\ H_2O.$$

In practice it is not possible to realise so perfect a reaction as is represented by this equation. A temporarily hard water softened by lime will still show a hardness of about three or four degrees. The best way of applying lime as a softener is undoubtedly in the form of lime water, but as the solubility of slaked lime in water (1 part of $Ca(OH)_2$ in about 700 parts of water) is small, the use of lime water involves storage tanks. It is therefore more usual when lime is used on the small scale to add it in the form of powdered slaked lime, made up into a milk with a little water. By calculation from the equation given above it is found that 100 parts of calcium carbonate dissolved in carbonic acid require 56 parts of quick lime (CaO) or 74 parts of slaked lime ($Ca(OH)_2$) for theoretically complete precipitation. If then the temporary hardness of a water has been determined, it is easy to ascertain the amount of lime which should be added as a first approximation to the best proportions for softening. In making preliminary experiments with lime it is as well to use a fair quantity of water, such for instance as ten gallons. Working on this amount each degree of temporary hardness will require 5·6 grains of quick lime or 7·4 grains of slaked lime. Assuming that a good lime from limestone contains about 90 per cent. of quicklime, the amount of lime on this basis theoretically required for the temporary hardness found should be added to the ten gallons and the water well stirred and left to settle for a few hours. The hardness may then be determined, and if the softening has not been sufficient a further trial with a larger proportion of lime can be made. There are several tests for ascertaining when sufficient lime has been added, but they are all better suited to experiments with lime water rather than with milk of lime, and in actual practice it will be found more satisfactory to rely on the determination of the hardness which will be found to rise again when an excess of lime has been added. With a little practice three experiments should be sufficient, and as they may be all started at once very little time need be spent over the trial. It is of course important to take a fair average sample of the lime to be used.

With most waters more lime will be required than is indicated by the temporary hardness, as there is in nearly all cases a larger amount of carbonic acid present than that which is necessary to hold the carbonates of calcium and magnesium in solution. If a water contains any appreciable amount of magnesium salts, such as chloride or sulphate, the action of lime on them produces magnesium hydroxide, part of which remains dissolved in the water and may be deposited by the action of heat, thus giving rise to trouble with the injector of the boiler. This difficulty may be overcome to a great extent by adding a little sodium bicarbonate to the water after the lime has acted for a short time.

It will be recognised from what has gone before that lime can only deal with temporary hardness. When a water is hard from the presence of calcium sulphate or chloride, the sulphate being the common form, and there is practically little dissolved calcium carbonate, the proper softening agent to use is sodium carbonate, the action of which is represented by the equation—

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4,$$

that is to say calcium sulphate and sodium carbonate yield insoluble calcium carbonate, while sodium sulphate goes into solution. A calculation shows that each degree of permanent hardness on 10 gallons of water requires 10·6 grains of pure sodium carbonate (Na_2CO_3).

Testing with soap solution will show whether the hardness has been satisfactorily removed, but it will not indicate whether too much sodium carbonate has been added. Excess is to be avoided, as, in addition to being wasteful, it may lead to serious priming in the boiler. In the next lecture the determination of the strength of alkaline solutions will be shortly described, and the method given then may be applied to the present case. When a water has both temporary and permanent hardness, the softening agents to be used are a mixture of lime and sodium carbonate or caustic soda ($NaOH$) by itself, or a mixture of caustic soda and sodium carbonate, or a mixture of lime and caustic soda. Which is best and what proportions of the ingredients of the mixtures are most suitable depend on the nature of the hardness, *i.e.*, on the relative amounts of temporary and permanent hardness. Waters vary also in the character of the deposit given with softening agents, and whether this settles or filters easily, will be found frequently to depend on the nature of the softener used. So far as this particular

point is concerned each water must be treated on its merits, but the general principles guiding the choice and application of softening agents for waters exhibiting mixed hardness, may be described briefly as follows :—

Caustic soda behaves in a similar way to lime with regard to temporary hardness—

$$CaCO_3 . H_2CO_3 + 2 NaOH = Ca CO_3 + Na_2CO_3 + H_2O,$$

but with this difference, that soluble sodium carbonate is formed at the same time. Now as sodium carbonate acts on permanent hardness thus—

$$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4,$$

it follows that if the two forms of hardness are in about equal proportions, the addition of an appropriate amount of caustic soda would effect a satisfactory softening. In the case of such a water, each degree of temporary hardness would require for 10 gallons of water 8 grains of caustic soda, and the sodium carbonate produced by the combination of the caustic soda with the carbonic acid which previously held the calcium carbonate in solution would deal with the permanent hardness. But here again it must be remembered that the water will contain some excess of carbonic acid, and a trial must therefore be made to ascertain if further softening can be effected by using a little more caustic soda than the amount which is theoretically indicated. Where the excess of carbonic acid is greater than that with which caustic soda can be considered to deal with economically, it is clear that the addition of some lime along with the caustic soda will save expense. Remembering that 80 parts of caustic soda are equivalent to 56 parts of quick lime, the proper amount of the latter may be calculated and added instead of the extra caustic soda found to be necessary over and above what was indicated as sufficient to deal with the hardness as such. A mixture of lime and carbonate of soda in water becomes calcium carbonate and caustic soda, if the quantities used are in proportion to their chemical equivalents as shown in the equation—

$$CaO. H_2O + Na_2CO_3 = CaCO_3 + 2 NaOH,$$

which indicates that 56 parts of quicklime and 106 parts of pure sodium carbonate yield 80 parts of caustic soda. Such a mixture may be used in the place of caustic soda, but it must be borne in mind that whenever lime is used a bulkier deposit is obtained than by the addition of alkali alone. When the water has to be filtered after softening it may be inconvenient to deal with a large amount of solid matter. When it is desirable to soften a water in which the proportions between the two forms of hardness are not equivalent, a mixture of lime and sodium carbonate, of lime and caustic soda, or of caustic soda and sodium carbonate may be used.

In the case of the temporary exceeding the permanent hardness, lime may be added equivalent to the temporary hardness and then sodium carbonate equivalent to the permanent hardness. Taking as before a volume of 10 gallons of water, the figures are 5·6 grains of quicklime for each degree of temporary hardness, and 10·6 grains of pure sodium carbonate for each degree of permanent hardness. If a mixture of lime and caustic soda is to be used on such a water, add caustic soda equivalent to the permanent hardness, and add lime equivalent to the number of degrees of hardness obtained by subtracting the permanent from the temporary hardness. For 10 gallons each degree of permanent hardness requires 8 grains of caustic soda. Taking as an example a water containing 15 degrees of temporary and 9 degrees of permanent hardness, the proportions used in a trial on 10 gallons were—caustic soda equivalent to 9 degrees of permanent hardness, $9 \times 8 = 72$ grains. Quicklime equivalent to $15 - 9 = 6°$ $5·6 \times 6 = 33·6$ grains. Thirty-four grains of quicklime were actually used and the water was softened to 5·5 degrees. It was not found to be economical to carry the softening below this amount.

When the permanent hardness is in excess of the temporary hardness a mixture of lime and sodium carbonate or one of caustic soda and sodium carbonate may be employed. A mixture of lime and caustic soda is seldom applicable in such a case, as in all probability there would not be sufficient extra carbonic acid present in the water to furnish, with the caustic soda when lime is present in addition, the requisite quantity of sodium carbonate for dealing with the permanent hardness.

Taking again a volume of 10 gallons for a trial experiment and using sodium carbonate and quicklime, 10·6 grains of pure sodium carbonate are added first for each degree of permanent hardness and then 5·6 grains of quicklime for each degree of temporary hardness.

With regard to the use of a mixture of caustic soda and sodium carbonate an experiment should be made first with caustic soda alone, as it may very well happen unless the

permanent hardness exceeds the temporary to a marked extent, that there is carbonic acid enough dissolved in the water to yield the necessary amount of sodium carbonate, and to give a satisfactory softening. If this is not found to be the case, and it is desired to use a mixture of caustic soda and sodium carbonate, a trial may be made in the following way. Add caustic soda equivalent to the temporary hardness and then sodium carbonate equivalent to the number of degrees of hardness obtained by subtracting the temporary from the permanent hardness. As a guide, take a theoretical example of a water containing 16 degrees of permanent and 6 degrees of temporary hardness. For 10 gallons add $6 \times 8 = 48$ grains of caustic soda. This amount, while removing the temporary hardness, will produce sodium carbonate sufficient to deal with 6 degrees of permanent hardness. Therefore more sodium carbonate equivalent to $16 - 6 = 10$ degrees must be now added, or $10 \times 10 \cdot 6 = 106$ grains Na_2CO_3. In actual practice it would most probably be found desirable to use more caustic soda than is indicated so as to take advantage of its formation of sodium carbonate with any extra dissolved carbonic acid, and to decrease the amount of sodium carbonate proportionately. Otherwise there would be the danger of leaving the water alkaline from sodium carbonate and bi-carbonate, with the accompanying objection with regard to its use in boilers.

It has been mentioned above that caustic soda acts on a water containing only temporary hardness in a similar manner to lime, but as sodium carbonate is formed at the same time and remains in solution, the use of caustic soda for softening a water of purely temporary hardness has not been recommended, not on account of any valid objection to such softened water for washing purposes, but because of the danger of priming when the same supply is used also in the boiler. The answer to the question, how far is it desirable to soften a water, must depend to some extent on the use to which the softened water is to be put. No doubt for washing purposes merely the water cannot be too soft, but the cost of removing the hardness almost completely may well exceed the loss due to the waste of soap caused by a moderate degree of hardness. Softening down to between four and six degrees may be considered to be as far as it is practicable to go with due regard to reasonable economy. Such a degree of hardness will eave a water in most cases in a fit condition to be used in a boiler for steam raising. Comparatively little deposit will come out of it, but some precipitate to cover the boiler plates and act as a protective coating is needed ; otherwise there is the danger of corrosion and pitting becoming apparent in the metal at some time or other. There is not time in this lecture to deal in any detail with the nature and causes of pitting, nor, indeed, would it be quite appropriate to do so, but the question of a remedy, should the defect tend to become serious, is of importance to workers in a power laundry; and the practical result of a very large number of experiments carried out at King's College, and extending over some years, may be given briefly in the form of directions for treatment. The quantities mentioned are for 310 gallons of water :—

(1.) Clear out the boiler, and fill up a little above the usual mark with water in which 20 lbs. of silicate of soda (soluble glass) have been dissolved. Boil for four hours or longer.

(2.) Run off when cold, and fill up with water containing 15 lbs. of barium hydrate ($Ba(OH)_2 . 8H_2O$) dissolved in it. Boil for four hours or longer.

(3.) After the boiler has been used for about a week put in 28 lbs. of chalk lime and boil for four hours or longer.

The period of four hours is given as a minimum, the actual time will depend on the convenience of the user of the boiler. It is, however, not advisable to allow more than three or four days to elapse between (1) and (2). Boilers treated in this way and which previously showed serious pitting have been constantly under observation for six years without any return or continuance of the mischief being apparent.

Before leaving the subject of water a very brief reference may be made to the substances used as boiler compositions or "anti-incrustators." Very many of them contain either caustic soda or sodium carbonate, and their use depends on the chemical action between them and the calcium salts in the water giving rise to a loose deposit and preventing the formation of the hard adherent and coherent coating which forms the objectionable scale derived from some waters, and more especially from those which contain calcium sulphate. It is clear that these alkalies should be used in quantities determined by the particular nature of the water, as any excess over and above that amount which is required for the reaction would tend to encourage priming. Sometimes the alkalies are mixed with various waste

organic substances, *e.g.*, sawdust, peat, tan, disintegrated leather clippings, &c. With certain waters the organic matter appears to have some useful action and to assist in preventing the setting of the substances which make up the scale into hard coherent masses. Another kind of boiler composition is to be found which contains ammonium chloride. The object of this is to convert the calcium carbonate into calcium chloride which is very soluble. At the same time, however, ammonium carbonate is formed, and as this is volatile and comes over with the steam it is very likely to produce serious corrosion of any copper or brass fittings. The use, therefore, of such a boiler composition is to be condemned in most cases. Whatever anti-incrustator is chosen, it should be used with a full knowledge of its composition and the nature and extent of its action.

Closely connected with water from a launderer's point of view, and of equal importance, is the subject of soaps. The details of their manufacture is outside the scope of the present lectures. As a rule soap is not made in the laundry but obtained from one of the many manufacturers. There are, however, some laundries in which the soaps required are made successfully, and with economy, and analyses of specimens of such soaps have proved them to be of very good character. There are probably few other materials in the manufacture of which the art of adulteration has been applied so extensively as it has been to soap. There are, however, many good soaps to be obtained of manufacturers of reputation, and it is the object of the remarks which follow to indicate as briefly as possible what constitutes a good soap for laundry purposes, and to give such directions for the application of simple tests as will enable the launderer to form an estimate of the value of soaps offered to him.

Soaps, as ordinarily understood, are either the sodium salts (hard soaps) or potassium salts (soft soaps) of fatty acids of relatively high molecular weight. Resin acids are also used in the manufacture of some soaps. The raw materials from which soaps are manufactured vary considerably, but they are, with the exception of resin, animal or vegetable fats or oils. Chemically they are described as the ethereal salts of glycerine and fatty acids, and the action of the caustic alkalies used to convert them into soaps consists in the production of the salts of the alkalies of the fatty acids of the fats or oils with the accompanying formation of glycerine. Such a change is generally known as an example of "hydrolysis," the term saponification, however, being more generally used to describe the special case of hydrolysis by alkalies at present under consideration. Taking glycerine oleate (generally called glyceryl oleate) as a typical example of an ethereal salt of a fatty nature, and caustic soda as the alkali used to effect its saponification, the reaction may be represented by the equation—

$$\underset{\substack{\text{glyceryl oleate} \\ (884)}}{C_3H_5\,(C_{18}H_{33}O_2)_3} + \underset{(3 \times 40 = 120)}{3\ NaOH} = \underset{\substack{\text{glycerine} \\ (92)}}{C_3H_5\,(OH)_3} + \underset{\substack{\text{sodium oleate} \\ (i.e.\ \text{soap}) \\ (3 \times 304 = 912)}}{3\ (NaC_{18}H_{33}O_2)}$$

The numbers in brackets underneath the names are the molecular weights and multiples of these weights in the case of the caustic soda and sodium oleate, and show the theoretical proportions of the fat and soda used, and of the glycerine and soap obtainable from them.

100 parts of good tallow require about 12·5 parts of caustic soda, and furnish about 103 parts of dry soap.

100 parts of cocoanut oil require about 19 parts of caustic soda and yield about 108 parts of dry soap.

These numbers are not given as anything more than a general guide and as useful to remember in view of the remarkable yields of soap which are sometimes obtained. For example, a mixture of the following nature can be made to furnish a material which will retain the shape given to it and exhibit some of the properties of soap—

100	parts	cocoa-nut oil.
15	,,	palm-nut oil.
75	,,	resin.
255	,,	soda lye (specific gravity 1·28).
250	,,	sodium silicate.
130	,,	filling, *e.g.* chalk, clay, &c.
825	,,	so-called soap.

It would lead too far from the purposes of this lecture to deal with the constitution of the different fats and oils which are worked up into soaps, but the following may be mentioned as examples, together with the names of the principal fatty acids contained in them in the form of ethereal salts of glycerine :—

Fat or oil.	Acids.
Tallow	Stearic, oleic, palmitic.
Olive oil	Oleic, palmitic, linoleic.
Palm oil	Palmitic, oleic (frequently a considerable proportion of the palmitic acid is in the free state).
Cotton-seed oil ..	Oleic, linoleic, stearic, palmitic.
Castor oil	Ricinoleic, stearic.
Cocoa-nut oil .... / Palm-nut oil	Myristic, lauric, palmitic, oleic.

The compounds made by the action of alkalies on a resin such as colophony consist mainly of the sodium salt of an acid of high molecular weight, known as abietic acid. The substances made by the action of alkalies on resins alone are hardly to be called soaps in the general acceptation of the term, but when fats and oils are saponified along with a certain amount of resin true soaps are obtained. The following Table gives the names and formulæ of the chief acids mentioned above, together with the molecular weights of their anhydrides, the weight of sodium oxide (Na_2O) required to convert the anhydrides into sodium salts of the acids and the percentages of alkali (Na_2O) present in the resulting dry soaps:—

Name of acid.	Formula.	Molecular weight of anhydride.	Weight of alkali (Na_2O).	Percentage of Na_2O.
Ricinoleic.	$C_{18}H_{34}O_3$	578	62	10·72
Stearic....	$C_{18}H_{36}O_2$	550	,,	11·27
Oleic	$C_{18}H_{34}O_2$	546	,,	11·37
Linoleic ..	$C_{18}H_{32}O_2$	542	,,	11·42
Palmitic .	$C_{16}H_{32}O_2$	494	,,	12·55
Myristic ..	$C_{14}H_{28}O_2$	438	,,	14·15
Lauric	$C_{12}H_{24}O_2$	382	,,	16·25

The molecular weights of the anhydrides, which are obtained by doubling those of the acids and subtracting the molecular weight of water, viz., 18, are given instead of the molecular weights of the acids themselves, as it is in the form of anhydrides that fatty acids are returned in the analyses of soaps. The reason is seen from the equation—

$$\underset{\text{stearic acid.}}{C_{18}H_{36}O_2} \times NaOH = \underset{\text{soap.}}{NaC_{18}H_{36}O_2} + \underset{\text{water which is eliminated.}}{H_2O}$$

As the alkali is expressed as sodium oxide (Na_2O), then $2(NaC_{18}H_{36}O_2)$ is to be looked upon as a compound of Na_2O, and $\begin{matrix}C_{18}H_{35}O\\C_{18}H_{35}O\end{matrix}\Big\rangle O$, *i.e.*, stearic anhydride. Adding together the numbers for anhydride and Na_2O will at once give the amount of dry soap.

It will be seen from the numbers for percentages of Na_2O given in the Table, that the higher the molecular weights of the acids are the smaller is the percentage of Na_2O present in the soaps made from them. It may be stated as a general rule and without troubling about details of certain exceptions, that experience shows that the soaps of acids of the same series of high molecular weight possess superior lathering properties over those made from acids lower in the series. Oleic acid stands very high in this respect, but in making comparisons the question of solubility must be taken into account, the alkaline salts of oleic acid being among the most soluble of all soaps. The molecular weight of the resin acid, abietic acid ($C_{44}H_{64}O_5$) is very high, and there is no doubt that the use of resin in making soap promotes the lathering properties of the product. This is a convenient opportunity to consider how far the presence of resin is permissible in soaps for laundry purpose. A large number of experiments were made under strictly comparable conditions with many soaps free from resin, and with soaps similar in other respects but containing various proportions of resin, and it was found that it was not a matter of opinion but a fact beyond question that linen and cotton goods repeatedly washed with soap containing resin became markedly more coloured of a yellowish-brown hue than equal portions of the same goods washed in the control experiments with soaps free from resin. The difference was quite noticeable even when the resin acids did not exceed 5 per cent. of the total fatty acids of the soap, and the higher the percentage of resin the more marked was the effect.

From what has been said it will be gathered that a good soap for laundry purposes will consist of the sodium or potassium salts of fatty acids of high molecular weight, a large proportion of these acids being oleic acid, associated with water and practically nothing else. It is clear, however, from the conditions of manufacture, that some small amount of alkali over and above that which is combined with the acids may be present. Glycerine also may form a constituent of soaps in small amounts only when its separation is part of the process of manufacture, and will be present in appreciable quantities when, as in the case of many soft soaps, no attempt is made to remove it. It is an advantage to any one engaged in conducting or directing the technical processes of modern laundry work to be able to carry out

such simple tests and experiments as will serve to make an estimate of the value of the materials employed. The tests and analytical methods connected with soaps which are to be described now as briefly as possible are not intended to be in any way complete or exhaustive. As a rule the launderer is not concerned with minute details but rather desires to ascertain the general value and order of purity of the soap supplied to him. His own experience is sufficient guide as to its efficiency. It is more with a view to criticising new and possibly better articles that he may wish to be able to apply tests which will give him some data to go upon before making an experiment with them on the large scale.

First, as regards the possible presence of resin. The simplest way of testing for this substance is to decompose a small quantity of the soap, say about 5 grams, by boiling it with water to which enough dilute sulphuric acid has been added to render the liquid distinctly acid, that is so that it reddens blue litmus paper freely throughout the process. The fatty acids will be set free and will float as an oily layer upon the watery solution. When the change is seen to be complete by the transparency and fluidity of the oily layer, the whole mixture is to be cooled until the fatty acids solidify, as they will in the case of all soaps except those which are unusually rich in alkaline oleates. A small portion, about the size of a pea, of the fatty acids separated and dried is then to be dissolved in about two cubic centimetres of acetic anhydride (not to be confused with anhydrous or glacial acetic acid) the solution being helped by gentle heat. After cooling this solution thoroughly, two or three drops of a cold mixture of equal volumes of glacial acetic acid and strong sulphuric acid are added, and if resin acids are present an unmistakeable violet colour will be produced. The colour is fugitive, but by keeping the solution cold and using the mixture of glacial acetic acid and strong sulphuric acid instead of sulphuric acid alone, it is possible with care and experience, and by taking precautions to conduct the experiment always in the same way and with the same quantities, and to operate on fairly weak solutions of the fatty acids, to form a rough judgment by means of this test of the relative amounts of resin by estimation of the depth of colour compared with that given by a soap containing a known amount of resin acids. In all soaps which are ever likely to be met with the only substance other than resin which will give a similar colour is cholesterol from wool fat. This may be eliminated by shaking a solution of the soap, before decomposing with sulphuric acid, with ether or petroleum ether, either of which will extract the cholesterol. The percentage of fatty acids present in a soap can be readily determined with moderate accuracy by decomposing 10 grams of soap with dilute sulphuric acid in the same way as has been just described. The cooled and solidified cake is separated, melted, and dried, and its weight determined when cold. Should the fatty acids be found to remain liquid or inconveniently pasty on cooling, the difficulty can be overcome by adding a known weight, about 5 grams, of beeswax or stearic acid to the mixture of soap and sulphuric acid, so that it may incorporate thoroughly with the fatty acids, and by its higher melting point confer solidity on them. The weight of added matter is of course allowed for in the determination. When this process is being carried out any filling of an insoluble nature such as talc, silicates, &c., will be revealed by a white precipitate settling on the bottom of the vessel.

An easy and simple method of forming an estimate of the amount of fatty acids contained in a soap is to use the standard calcium chloride solution described under the determination of the hardness of water. A solution of the soap in question is made up in the proportions of 10 grams to a litre of weak alcohol, and used with the calcium solution in the manner explained for the valuation of the standard soap solution. Assuming that this standard solution was made from a soap of acknowledged purity and high fatty acid content, the relative value of any other soap can in this manner be ascertained quickly and with fair accuracy.

The amount of water in a soap can be found with fair accuracy by heating 5 grams in a vessel such as a porcelain dish or crucible large enough to allow of the soap being stirred freely with a glass rod which has been weighed along with the vessel. The heating is continued until a cold watch-glass, or failing that, a plate of glass laid on the vessel from time to time ceases to be dimmed by moisture. An argand gas burner turned down very low is a convenient source of heat; but, whatever is used, care must be taken not to burn the soap. The loss of water is determined by weighing after the vessel and its contents have become quite cold. The total alkali in a soap consists of the alkali combined with the fatty acids and

of that which is present either as free caustic soda or potash or as sodium or potassium carbonates, and sometimes borates and silicates. In the process described above of separating the fatty acids by boiling with dilute sulphuric acid, the total alkali of the soap combines with and neutralises a part of the sulphuric acid. If, then, the strength and volume of this acid used are known, and a determination by means of an alkaline solution of known value is made of the excess of free sulphuric acid, left after all the soap has been decomposed, a simple calculation will give the amount of total alkali present in the soap. The two processes of determining the fatty acids may thus be combined together, but it is generally more convenient to take a smaller weight such as 4 grams of soap for the total alkali, and to make the determination separately. For the details of preparing and using standardised acid and alkaline solutions reference is made to the next lecture under alkalies used in laundry work.

The presence of alkali other than that combined with fatty acids may be shown and determined in the following way. A weighed quantity of the soap such as 4 grams in fine shavings is dissolved in boiling alcohol which should be of not less than 90 per cent. strength. Methylated spirit can be used if it has been left for some time in contact with lumps of good quicklime in a stoppered bottle. It should be filtered before use. If the soap is one containing very much water it should be gently heated, without melting, after it has been weighed, so as to expel the greater part of the water. The soap and any free caustic alkali dissolve in the alcohol leaving the alkaline carbonates, borates or silicates as an insoluble residue mixed with any filling, common salt, &c., which may be present in the soap. The hot alcoholic solution is filtered, and the residue on the filter is washed free from soap with successive portions of fresh hot alcohol. Roughly speaking, the total amount of alcohol required for the whole process will be about 5 fluid ozs. (150 cubic centimetres). The residue is treated on the filter with distilled water until the soluble alkaline carbonates have been washed through. Their amount can then be determined by finding the quantity of acid of known strength required to neutralise them. As the alkaline carbonates are the only form of alkali likely to be met with in the residue insoluble in alcohol, so far as ordinary soaps for laundry work are concerned, there is no occasion to deal with the question of the separation and estimation of borates and silicates, which would involve analytical processes beyond the scope of the present lecture. Practice and experience will make it quite possible to determine the alkaline carbonate on a smaller quantity of soap than that mentioned with sufficient accuracy for most purposes. Indeed, after considerable acquaintance with the appearance of solutions in alcohol of soaps containing varying amounts of alkaline carbonate, it is by no means difficult to form a very fair judgment of the quantity present by dissolving half a gram of soap in 10 cubic centimetres of hot alcohol in a test tube, and noting the extent of the turbidity. This, of course, only applies to straightforward soaps, in which there is no reason to suspect the presence of any filling, salts, or matter other than alkaline carbonate insoluble in alcohol.

Except in the case of some soft soaps freshly prepared, it is not usual to find free caustic alkali in soap supplied for laundry work. Should any be present it will be found, as has been stated, in the alcoholic solution along with the soap. It can be tested for by adding a drop or two of an alcoholic solution of phenolphthalein, a substance which will give a strong red colour with the alkali. The amount of caustic alkali, if any is found, can be determined by cautiously adding acid of known strength, and noting the amount used to make the red colour disappear. It will sometimes be found that, instead of the alcoholic solution of soap after it has been filtered from alkaline carbonate being alkaline, it is, on the contrary, slightly acid. This is due to the presence of acid steareates, oleates, &c., or to fatty acids. Except in badly-made soaps, the extent of this acidity will be but small, and need not be considered.

Unsaponified fat and unsaponified waxes or oils are very seldom met with in soaps such as are being considered. Should, however, the behaviour of a soap give the launderer any reason to suspect their presence, they may be found in the following manner. About 5 grams of the soap are dissolved in distilled water, and if the solution does not give a red colour with a drop or two of phenolphthalein a little caustic soda or potash is added until it does so. The object of this is to neutralise any free fatty acids which might be present, and which would dissolve in the ether which is to be used for extracting the unsaponified fats. The cold soap solution is then shaken up with ether and the ethereal layer is separated from the lower aqueous layer. The

ethereal solution is washed by shaking it up with about its own volume of water to remove the small amount of soap which dissolves when a moderately strong solution of it is shaken with ether. After again separating the two layers, the ether is evaporated in a suitable vessel over hot water, when the unsaponified fat or unsaponifiable oils will be left, and can, if necessary, be weighed. The amount of ether to be used need not be greater than that which will give a manageable separate layer after shaking up with the soap solution, the volume of which will necessarily be governed to a great extent by the solubility of the particular soap in cold water. The following table of results will give a fair idea of the proportion of the chief ingredients which may reasonably be expected in soaps intended for use in a laundry. The percentages are from analyses made of soaps either used recently in laundries or offered for use. Some details have been omitted to avoid unnecessary complication, and only the main constituents are mentioned. Glycerine, although separately determined, has been included with water, and the insoluble matter mentioned was, in most cases, insignificant in amount :—

	Oil Soaps.		Mottled Soaps.		
Fatty anhydrides	59·65	66·1	63·24	69·50	70·50
Combined alkali (Na_2O)	7·75	7·65	8·48	9·25	9·50
Free alkali (Na_2CO_3) ..	0·31	1·64	0·40	0·45	trace
Water and insoluble matter	32·29	24·61	27·88	20·80	20·00

All of these soaps may be considered to be of good average quality and it will be seen that with one exception the amount of free alkali reckoned as sodium carbonate is low. An average of not more than 0·5 per cent. is what may reasonably be expected in an ordinary laundry soap. It may be said that as additional alkali is often used there is no harm in having a larger percentage of it in the soap, but it is clear that it is far better to be able to add what is wanted separately, and to be sure of a soap which can be used when alkali might be injurious, to say nothing of the difference in cost between sodium carbonate and soap. The last soap strongly resembled old mottled soaps of good quality. At one time mottling was a guarantee of fair dryness in a soap since the segregation of the dirt into lines as the soap cooled and solidified was not possible, if the amount of water exceeded 20 per cent. Mottling is, however, no evidence of absence of excess of water at the present time as the addition of sodium silicate among other things prevents the too rapid settling of dirt or added coloured matter, and makes it possible to obtain a mottled appearance with a high percentage of water. A comparison of a very fair unmottled and a recent mottled soap will illustrate this.

	Unmottled soap.	Poor mottled soap.
Fatty anhydrides	66·25	42·41
Combined alkali (Na_2O)	8·34	4·57
Free alkali as Na_3Co_2, and as sodium silicate	0·42	2·23
Silica	none	1·56
Sodium chloride............	0·13	1·24
Sodium sulphate............	trace	0·53
Water and insoluble matter..	24·86	47·46
Percentage of true soap	74·59	46·98

The worst soap which has yet been examined, and which was offered as a good and economical washing soap for laundry purposes, had the following general constitution :—

True soap	16·03 per cent.
Sodum carbonate and silicate ..	19·24 ,, ,,
Sodium chloride and sulphate..	5·43 ,, ,,
Water and dirt	59·30 ,, ,,

It is, perhaps, needless to comment on such a soap as this, but the fact that it could be actually recommended emphasises the necessity of a general knowledge of the methods of testing soap on the part of the launderer, not only for his own protection, but that justice may be done to the many honest soaps which are manufactured for his use.

Soft soaps are frequently made in the laundry, and in most cases with very satisfactory results. As these soaps are often used for washing woollen goods, it is important that they should contain as small an amount as possible of free caustic alkali, the presence of which in any appreciable quantity would seriously damage the fibre. When soft soap is exposed to the air for some time most of the caustic alkali which might have been present at first would become converted into carbonate by the action of carbonic acid in the atmosphere. A comparison of the percentages of the main ingredients in a sample of fresh soft soap made in a laundry, and in a sample of a commercial article made some time ago, will illustrate this, and will give a general idea of the constitution of a soft soap :—

	Fresh soft soap.		Older soft soap.
Fatty anhydrides	54·62	..	43·50
Combined alkali as K_2O....	9·21	..	8·35
Free caustic alkali as KOH	0·62	..	trace
Free alkali as K_2CO_3	0·30	..	1·74
Water and glycerine	35·25	..	46·41

The glycerine, although separately determined, is given here with the water to avoid unnecessary detail.

A brief reference may be made to soap powders. They are, as a rule, mixtures of some soap with varying proportions of alkali in the form of carbonates associated sometimes with alkaline silicates or borates, and are offered to the launderer as efficient and economical substitutes for the soap and alkali which he is in the habit of using. In view of the price charged for many which have been examined, and of the constitution of them revealed by analysis, it is difficult to see how any advantage can accrue to him by their use. The following analyses of three soap powders will make this evident. Two are very similar in composition, while the third is a mere pretence so far as soap is concerned :—

	A	B	C
Fatty anhydrides	22·12	19·73	2·76
Combined alkali (Na_2O)	3·68	3·26	0·42
Sodium carbonate	28·09	27·52	23·14
Sodium chloride	0·32	1·33	1·75
Sodium silicate........	none	trace	12·64
Sodium sulphate	0·12	0·31	5·37
Insoluble residue	3·80	5·58	8·15
Water	41·87	42·27	45·77

There is nothing in A and B which cannot be better applied in the form of separate ingredients, with the advantage that the useless insoluble matter can be left out. No criticism of C is needed.

In the third lecture the action of soap as a detergent will be specially considered, along with some of its properties, which have been necessarily omitted here.

INSANITY.

The figures to be found in the sixty-first report of the Commissioners in Lunacy, would seem to show that insanity is largely on the increase in England and Wales. On the 1st January, 1907, the total number of notified insane persons in England and Wales stood to the estimated population in the proportion of 1 to 282, or 35·48 per 10,000. This gives an increase on the ratio of the preceding year of 0·48 per cent., whilst the actual numerical increase has been 1·64 per cent. On the 1st January, 1897, this ratio was 31·89, so that in the ten years it has increased by 11·3 per cent., the proportion of such insane persons in the whole community having risen from 1 to 314 to 1 to 282. The actual increase in the whole population during the same period was 12·1 per cent., and in the numbers of the certified insane 24·8 per cent. Calculating the admission rate per annum on 10,000 of population, it will be found that in the year 1869 this was 4·71, in 1902 this ratio was higher than that of 1869 by 47·1 per cent., and in 1906 by 34·0 per cent. From 1869 to 1906 the population of England and Wales increased by 55·5 per cent., the total (known) insane by 133 per cent. The admissions which in 1869 were 10,472, rose to 21,812 in 1906, an increase of 108·2 per cent. But the ratio of insane to population which, on 1st January, 1869, was 23·93 per 10,000, had risen to 35·48 on the 1st January, 1907—an increase of 48·2 per cent.

It has been authoritatively stated that the "only proper test of the increase of mental disease is the proportion of first attacks to the population during different periods." If the figures bearing on this point given by the Commissioners are taken, and the test accepted, the conclusion suggested by the figures given above as to the increase of insanity would appear to be confirmed. The statistics of institutions for the insane afford opportunity for an estimate of the proportion of "first attacks." From a study of the annual averages calculated on the figures of each of the six quinquennial divisions into which this term is divisible, and contrasting the total annual admissions with the totals of ascertained first attacks of insanity, it would appear that the latter have increased absolutely and relatively (to population) to a greater extent than the former. Thus the quinquennial average of male admissions has risen from 6,449 to 10,741, and of females from 6,653 to 11,179 in the years 1876-80 and 1901-5 respectively, giving a rate of increase for males of 66·5 per cent., and for females of 68·0 per cent. As regards these first attacks of insanity, the increase for males has been 75·7 and for females 71·9 per cent. in the like period. If the ratios from 10,000 of the population be taken the result is as follows :—

Ratio per 10,000 of Population of the Annual Average.

	1876-80.		1891-95.		1901-05.
Males—					
Admissions....	5·29	....	5·91	....	6·65
First Attacks ..	3·48	....	4·01	....	4·62
Females—					
Admissions....	5·17	....	5·88	....	6·48
First Attacks ..	3·36	....	3·87	....	4·31

It is only during the past decade that any marked preponderance of cases admitted with their first attack of insanity has occurred. Whilst contrasting the first of the six quinquenniums with the last, it will

be seen that whilst the ratio of total admissions has risen, for males 25·7 per cent., and for females 25·3 per cent., the ratio of "first attacks" has increased by 32·7 per cent. in the case of males, and 28·2 per cent. in that of females. But the Commissioners point out that there are factors to be considered which render it impossible to determine whether the actual proportion of "occurring" insanity is really increasing in the community, and if it be so to what extent. It is probable that far more care is taken to segregate persons suffering from the milder forms of insanity than used to be the case, fitness for detention being considered to imply the need for treatment of a disease quite as much as the fact that the insane person requires protection from himself, or that the community has to be protected from him; and, again, in the case of the aged, whose numbers go to swell the list of "first attacks," removal to asylums is well known to be on the increase. Hence it happens that without any marked increase in the prevalence of mental disorder many such defectives are now being notified who a generation or two ago would have been left outside the pale of official recognition. Such statistics, then, as are alone obtainable, which seem to point to an increase of insanity in the community, are too open to qualification to justify such a conclusion. They deal only with those who have been certified as insane and proper subjects for detention, and their numbers from year to year are influenced by factors the extent of which cannot be estimated. Lastly, the rise in proportion of the numbers of "first attack" cases encourages the belief that the early treatment of the insane is more fully carried out than in former days; whilst the corresponding diminution of *not* first attacks points to the efficacy of such treatment in preventing recurrence of the disorder.

In the fifty-ninth report of the Commissioners attention was drawn to the fact—which must be obvious from a study of the recovery rates of the insane—that there is a constant and considerable flux of patients into and out of asylums. (See *Journal*, October 27th, 1905.) But the material at the disposal of the Commissioners did not permit of any detailed analysis in respect to the proportions who had been discharged on recovery, or removal by death. The Commissioners in their present report attempt such analysis by utilising for this purpose an instructive Table printed in the annual reports of the majority of the county and borough asylums. The Table gives, on the one hand, the numbers admitted in each year from the opening of the asylum, separating the re-admissions; and, on the other, the number of those so admitted who, up to the close of the year of the report, had been discharged "recovered," "relieved," and "not improved;" those who had died during the same period; and finally those who still remained under treatment. The figures of 43 asylums were taken over a period of 20 years—1886 to 1905—with the object of showing what changes occurred in the distribution of those of their inmates who were admitted at periods of 20, 15, 10, 5, and within one year. Taking only the 8009 patients admitted into these 43 asylums during the year 1886, and tracing their fate in successive years up to the end of 1905, we have the following percentages:—

Of each 100 *admissions in* 1886.

	Dis-charg'd.	Died.	Re-mained.
To the end of 1886 (within 1 year)	25·0	10·0	65·0
" " 1887 (" 2 years)	42·4	17·0	40·0
" " 1888 (" 3 ")	47·0	22·0	31·0
" " 1889 (" 4 ")	50·3	24·2	25·5
" " 1890 (" 5 ")	51·8	26·4	21·8
" " 1895 (" 10 ")	55·2	31·0	13·8
" " 1905 (" 20 ")	57·7	36·1	0·2

It will be observed that by far the majority who were discharged recovered left the asylums within two years of being admitted.

THE SCHOLARSHIP SYSTEM AT OXFORD AND CAMBRIDGE.*

The present system of open scholarships at the older universities owes its existence to Richard Jenkyns, Master of Balliol, 1819-1854. Until about eighty years ago help was given to students in two ways. There were scholarships, confined to particular schools, districts, or families, and there were servitorships or sizarships, the holders of which did not necessarily possess very high intellectual qualifications, but who were essentially poor men. Jenkyns's system was the offering of scholarships, after a competitive examination, to school boys without any reference to the question as to whether the money was or was not needed for their university education. The status of scholars was improved, and they were made to rank in the college immediately after the fellows. In a short time many of the most brilliant boys in public schools were attracted to the universities, and what was more important, there was an improvement in the work of the schools, which benefited not only the prospective scholars, but also the rank and file of the school. The competition for open scholarships is perhaps keener in our own day than it has ever been, and the success of a school is now guaged, quite wrongly in my opinion, by the number of open scholarships it can claim at the end of the school year.

It has been several times suggested during the last few years that the scholarship system involves a great waste of money, and schemes have been proposed which, while retaining the stimulus of competition, give the money only where it is needed. This seems the only logical position, and were the question as simple as it sounds few would hesitate to adopt one or other of the solutions. The most recent of these proposals is briefly this, that all entrance scholarships

* Abstract of a paper by Dr. H. B. Baker, F.R.S., read before Section L of the British Association Meeting, at Leicester.

should be of the value of £40 a year, and that they should only be increased when the parent could prove that the increase was necessary. On the face of it the proposal seems reasonable, with the one exception that the giving of £40 a year to a scholar who does not need it seems a half-hearted measure.

Exaggerated statements of the waste of money given in scholarships are so often made that an attempt to arrive at an approximation to the facts should be of interest. The heads of all colleges at Oxford and Cambridge were asked to give an estimate of the proportion of their scholars during the last ten years who could have afforded to reside at the university without the aid of their emoluments. Acknowledgment is gratefully made of the kindness of these gentlemen and of the tutors of colleges in compiling the statistics which it is now possible to bring before the Section. The estimates show that at Cambridge 17 per cent. of scholars could have resided at the university without their scholarships, while at Oxford the proportion is only 6 per cent. But even in many of these few cases it was very largely the opinion of my correspondents that the money given in scholarships was not misused. The head of the college at Oxford which had apparently the largest percentage of wealthy scholars, pointed out that they were largely sons of professional men whose incomes are uncertain. In these cases if the father happens to die during his son's university career there is no possibility of the boy's education being completed without external aid. Many have pointed out the difficulty in dealing with the figures supplied by parents with the object of proving poverty. Others consider that if scholarships were made purely eleemosynary the status of scholars would immediately fall, and a condition of things spring up which exists, to their great detriment, in some of the American universities. It must be remembered that the social life of the older universities is one of the most important things to a youth, and anything which would tend to diminish its educational value is much to be deprecated. Considering the disadvantages which the new scheme presents, I would advocate two alternatives. First, let there be a voluntary relinquishment of the emoluments of a scholarship by a wealthy parent, the other privileges of the scholar being retained. It would soon become a point of honour for a wealthy man to refuse to accept money which would be so useful to poor men. Second, let a former scholar who has attained in later life to a position of comparative opulence, pay back his scholarships in some way or other for the help of other poor scholars. With regard to the first of these proposals, I may point out that it is occasionally carried into effect. At one Oxford college six out of twelve wealthy scholars have during the last ten years refused the emoluments of their scholarships, and isolated instances have occurred at other colleges. With regard to the second proposal, *cum veniret ad pinguiorem fortunam* (when a man has attained to fatter fortune), as the St. Andrews statute has it, he should pay back the money which was the foundation of his fortune. This also is done, and perhaps more often than is known. Occasionally the whole sum is paid back to a college, but more frequently the former scholar, out of the not very fat fortune of a schoolmaster or college tutor, pays the sum back in helping poor scholars at the university.

Either of these systems of relieving college funds would, if backed by the force of public opinion, relieve an amount of hardship and poverty which is scarcely realised by any who have not been either poor scholars themselves or been brought into intimate contact with them. The cost of living varies very greatly at different colleges. It is possible to live with economy at many colleges on £120 a year. Two of my own pupils at Christ Church have managed with self-denial to limit their expenses to £110 a year. Since an open scholarship is £80 a year, and school-leaving exhibitions may give a man another £20 a year, it is not difficult to see that the very poor man has still need of assistance. Most colleges have an exhibition fund from which grants are privately made to the poorest students, and anyone who is willing to pay back his scholarship by the help of which, it may be, he has attained a good position, could hardly do better than contribute the money to such a fund.

JAPAN'S TEXTILE MACHINERY.

At present Japan is a better field for the sale of machinery needed to make finished products than for the manufactured products themselves. In no line of business is this truer than in cotton manufacturing. Japan is straining every nerve to change from a consuming to a producing nation, and it is expected that a great amount of money will be put into textile machinery in the next few years. The tendency of all the mills is to add looms and make cloth for the export trade. The great market for cloth of the kind that can readily be made by Japan in Manchuria and Corea has stimulated the weaving mills, while the yarn business has to withstand severe competition in China with Indian yarn. Many Japanese yarn mills are considering the question of changing to weaving mills, and several have recently done so. The textile machinery market is dominated by British manufacturers to an even larger degree than the textile market. The first mill in Japan that was a success, had English machinery, and the other mills followed. Machinery from Oldham, Blackburn, Burnley, &c., is found in all the Japanese mills, but very little American. According to a recent report of a special agent of the United States Government, there is some prejudice against American textile machinery as being too high in price and too light in construction. Notwithstanding his dexterity in certain lines of manufacture, the average Japanese is a very rough workman, and the managers, therefore, prefer heavy machinery from England to the American article.

The textile machinery imports are increasing rapidly. In 1905 the value of cotton printing machinery brought into Japan amounted to £2,230, of cotton spinning machinery £122,820, and of cotton weaving machinery £38,660. There are several new factories being projected, and established mills are being enlarged, so that if the question of raising more revenue is settled by the Diet without burdening manufacturing industries too much, there will probably be between 50,000 and 100,000 new spindles installed during the year 1907. The Kanegafuchi Spinning Company, whose head office is at Kobe, intend to send their superintendent to England to select machinery for a large saw mill they have decided to erect at Harima, and which they intend to make a model mill. A new mill, to be known as the Oriental, is to be shortly established near Amagasaki, for weaving calico. The proposed equipment is 500 looms, 20,000 spindles for No. 42 yarn, and 10,000 spindles for finer yarn. The Fuhushima mill at Osaka has decided to add 20,000 spindles, so as to increase its yarn production for shipment to China. Several other mills are now being organised, and others are ordering additional machinery. It is by means of exhibitions showing the manufactured products of Japan, held by business men, and encouraged by the Government, that the country is being steadily pushed forward into the line of manufacturing nations, and the Gonikai Exhibition, which has recently been held, showed great diversity of manufactures. The leading lines exhibited were textiles, silk yarn and silk cloth, cotton yarn and cotton piece goods, blankets of all kinds, both woollen and cotton, and hand and machine-made matting. There was also an important exhibit of rugs made with cotton warp and rice straw filling. Also many cotton carpets. The great majority of the cotton piece goods were prints put up in bolts about fifteen inches wide, and about thirteen yards long. The goods were for sale, as well as for exhibition. Each bolt was put up in an attractive manner, and a large number of them had silk thread attached for use in making up the garments. A good many pieces are sold rolled, instead of folded. One Japanese cotton mill, the Tsushima Spinning Company, in Owari Province, in Central Japan, has 100 looms working on fifteen inch print cloth, but the majority of the immense quantities of narrow prints made, and used so extensively for *kimonos*, are made on hand looms. The price is from twopence farthing to threepence halfpenny per yard. In addition to the narrow cotton prints, which were the main exhibits of cotton piece goods, there were also interesting exhibits of the goods made in the mills in Japan, composing mostly grey sheetings, drills, cotton crape and cotton flannel, also some duck, and shirtings, and twills. One of the most interesting sights at the Gonikai Exhibition consisted of the three new Japanese invented looms, and as showing what Japan is doing in the way of invention, they were of importance. They are inferior to the British, and also to the American looms, but they are ingenious, and serve to illustrate the growing determination of the Japanese to strike out along new lines, and to manufacture their own textile machinery as well as their own textiles. What first strikes the observer is the amount of wood used. The frames of all three were of wood, and wood s used wherever practicable, such as loom beam heads, whip rolls, levers, shuttle boxes, &c. The largest loom was labelled "The one Tsuda system Habutai Power Loom," and was made by the Matsuwo Works, Azabuku, Tokyo. It is used for weaving the transparent "habutai," about thirty-six inches in width. Except for the wood used, and modifications in details, this loom is not important.

The next loom is for weaving silk or cotton cloth, about twenty-four inches wide, and is notable for its method of harness raising for its stop motion, and also for being self-contained—that is, no driving belts, pullies, gears, or levers being outside the framework. The driven pulley is under the loom at the middle of the cam shaft, and is belted from below, and belt shifted by foot lever at front of the loom. There are no cams, treadles, or strapping used to work the harness. The two harnesses used have wooden ends, and slide in grooves in the frame work. To the centre of each heddle frame end is fastened a curved iron rod, the other end of which is attached to a short set-screwed crank arm on the cam shaft. As the cam-shaft revolves this crank arm through this rod imparts a reciprocal up and down motion to the harness, and by means of the set-screwed arm their motion relative to each other, and to the lay, can be adjusted. The width of shed can be regulated by changing length of rod where it joins the crank arm. The picking motion is also peculiar. While the picker stick is thrown with cams, levers, and lug straps in the usual way, the picker stick proper is under the loom, and half the usual length. It is of wood, but at the top there is hinged by means of a screw an iron rod that runs out horizontally, and curves up into the shuttle box, and the end of this rod carries the picker firmly attached. With this arrangement, owing to the hinge construction, the picker moves in a straight line. This loom also has an ingenious warp-stop motion attachment operating through the heddles. The third loom is used for weaving the narrow print cloth that is usually made about thirteen and a half inches wide. It shows more points of dissimilarity from the usual styles, and so is of more interest than the others. No lug straps are used, but the power is applied to the picker stick by means of a lever striking a casting on foot of picker stick. The foot of the picker stick is bolted into a casting that is pivotted on a horizontal bolt from another casting on the end of the sword rock shaft. A wooden lever is pivotted at the back of the loom on the side, and its front end rests on the projecting casting attached to the foot of the picker stick. An iron piece with projection is bolted to the middle of this lever. The end of cam shaft projects beyond the loom, and carries a free roller on the

crank pin of a short crank arm set-screwed on the end of the cam shaft. As the cam shaft revolves, the roller is carried round and strikes the casting on the lever, which is forced down and strikes the projection on the pivotted casting carrying the picker stick, thus causing the loom to picker. The picker stick is brought back into position by a spring arrangement. The picker is loose on the end of the picker stick, and kept in position by the sides and top of the wooden shuttle boxes. This picking motion is patterned after a common English make, but is modified. The shuttle boxes being made of wood, there is no binder used to check the shuttle and prevent rebounding. The checking is accomplished by two loops of leather, one inside the other fastened with thumbscrew to projection under the end of the lay. The last two looms were made by the Toyoda Shokai Company at Nagoya. The company made in all four styles of looms, viz., (1) The wide loom for thirty to thirty-six inch cloth with iron frame: this loom has not been a success, and fifty of them tried at the Kanegafuchi Mills are to be replaced by English looms; (2) the narrow loom with iron frame; (3) the narrow loom with wood frame; and (4) the narrow loom with wood frame and automatic stop motion. The third is the most popular, and it is said that about three hundred a month are being turned out, the majority of them going to small hand and power loom establishments scattered throughout the Empire.

YUCATAN FIBRES.

Sisal grass or hemp, henequin, or simply sisal, are the various commercial terms applied to a fibre that is neither a grass nor a hemp. The term "sisal" was applied to it because it originally reached the outer world through the Yucatan port of that name. The agave, according to the American Consul at Progreso, is one of the most characteristic plants of Mexico. One species produces pulque, the intoxicating drink of the country. Great fields of this plant are found upon the table lands, and long pulque trains are run daily into Mexico city. The *Agave sisalensis*, another species, furnishes a fibre capable of binding wheat. There are four varieties of this plant growing wild in the forests of Yucatan —the chelm, cahum, pabci, and the citamci. There are also two varieties of the cultivated plant—the yaxci or green fibre, and the sacci, or white fibre. The last-named is the most largely cultivated and the one producing the sisal hemp of commerce. The fibre-cleaning machines in use in Yucatan, in order of precedence by priority of invention, consist of what are called the pacché, the tonkas, and the raspador. The pacché is a triangular, sharp-edged piece of wood, with rounded ends as handles. A wood log with a flat face is made with a hole and a peg in the upper portion. One end of the leaf of the plant is firmly fixed in the flat surface by jamming it into the hole and pushing the plug in after it; then the pulp is scraped away, leaving the fibre hanging from the uncleaned half of the leaf. The leaf is then reversed, the clean fibre fixed into the hole, and the uncleaned portion made ready for the action of the cleaner. The tonkas is a flattened piece of hard wood, about eighteen inches long by five inches wide. At the upper end it is about one inch thick, and it dwindles until at end it becomes a thin, sharp edge, curving inward, so as to grip and save the pulp from the fibre. The bed-board of the tonkas has a curve to coreespond with the curve in the edge of the implement. The leaf is placed between the bed-piece and the tonkas, and while the tonkas is held firmly in one hand, the other draws the leaf towards the body, this movement being repeated until one-half of the leaf is clean. The same operation takes place on the second half of the leaf. The pacché is the implement most in use to-day among the natives of the interior of Yucatan, and with which one person can produce from six to nine pounds of fibre daily. The next step in the evolution of the fibre-cleaning machine is the raspador, which in principle is a wheel upon which are placed the edges of many pacchés. With the aid of this machine two men can clean in one day more than forty men are able to accomplish with the tonkas and pacchés. There are many other labour-saving devices, some of them proving very effective. The total output of sisal hemp from Yucatan during the year 1906, was 600,000 bales, weighing 214 million pounds, and having a value of £2,700,000.

ROADS IN YUNNAN.

In his report on the trade of Mentgtzu just issued (Cd. 3727-15) Mr. Consul-General Wilkinson refers to the great want of roads in Yunnan province. Except for the stretch between Laokai and Manhao (both in the Red River) and a few miles across the larger lakes, there is no water carriage in Yunnan. Everything has to be carried on the backs of men, mules, ponies, or bullocks. A mint has lately been erected at Yunnan, and machinery reached Laokai several months before the date of the Consul-General's report. The machinery was brought to Laokai by rail from Haiphong, then placed on board junks which sailed or were towed up the river to Manhao. Thence each heavier section was being painfully hauled on a crude waggon by gangs of 20 to 30 men over the most appalling of roads, the main route mounting 6,000 feet in the first two or three miles. Nowhere in China, except, perhaps, in the sister province of Kueichow, are railways, or the construction and upkeep of properly graded roads, more needed. In their absence the wear and tear on man, beast, and package continues to the inevitable dislodgement of trade. The only scientific improvements so far essayed in Yunnan are the French railway now being built from Laokai on the Tongking frontier to Yunnanfu, and the continuation to Manhsien of the carriage road between Bhamo, on the Irrawadi and the Kulikha.

HOME INDUSTRIES.

Ventilation in Coal Mines.—The Government have appointed an expert mining engineer to investigate and report on the conditions of ventilation prevailing in coal mines in the United Kingdom. The appointment is the direct outcome of the report of the Royal Commission on Mines. It is not in dispute that much remains to be done in the matter of the better ventilation of mines. Inspectors complain that the language of the Act puts them at disadvantage when prosecuting the owners of ill-ventilated mines, owing to the vagueness of the legal definition of "adequate ventilation." What is adequate ventilation? Proper ventilation in a coal mine is a much more difficult matter than in a factory. In the latter, when an adequate system of ventilation is laid down it suffices until there is extension or re-building, but in a coal mine the conditions are constantly changed, and varying quantities of air are required in different parts of the mine as the position of the workings are altered. Leakage of air into old workings is another difficulty. There is need for more accurate marking of all ventilation currents on the colliery plans, and the driving of air-crossings in the solid rock as a safeguard against short circuiting of the air supply after explosions or subsidencies. These and other points will, no doubt, be reported on by the expert who has been appointed by the Government, and it may be hoped that his investigations will result in measures being taken to rectify admitted shortcomings in the ventilation systems of coal mines.

Wheat Supplies.—It is many years since the British farmer was so favourably placed in respect to his wheat crop. Speaking generally there has been an average crop, splendidly harvested, and commanding prices higher than any of recent years, with the prospect of much higher quotations for those who can afford to hold until the winter. During the past week there has been a further advance of from 2s. 6d. to 3s. 6d. per quarter. Wheat is now over 40s. per quarter, and owes nothing of the enhanced price to market manipulations. A study of the position warrants the conclusion that there will be further and even larger advances in price. The wants of the importing countries this season may be put at about 72,500,000 qrs.; the maximum prospective supplies do not exceed 65,000,000 qrs. The October report of the Washington Bureau may be taken as indicating the actual results of the crops in America, and it shows that whilst in 1905 the yield of wheat was, roughly, 700,000,000 bushels, and in 1906 735,000,000, in 1907 it is only 625,000,000 bushels. The reports from Canada show that there, too, there will be serious shrinkage, whilst from other quarters the reports are somewhat disturbing. In New South Wales and Victoria, the crops are said to be likely to be a failure owing to drought, and the reports from India, which of late years has given us so much of our wheat, are very serious. It is said that there is a serious failure of the native food crops, and that the sowing of the new wheat crop has been rendered impossible in large districts by the absence of rain. The reports from Argentine continue to point to good crops, but even there, it is said, early frosts are causing some anxiety. It is true that there is a surplus of nearly three million quarters in France, but a country which imposes an import duty of 12s. 6d. per 480 lbs. is hardly likely to become an exporter. Having regard to all the circumstances, it is difficult to avoid the conclusion that the price of wheat will rule very high during the coming winter.

False Trade Descriptions.—British manufacturers have serious cause of complaint against foreign rivals in the matter of false trade descriptions, and perhaps in no country have these descriptions been more common than in France. Complaints have been addressed to the French Government, which has inquired into the matter, and has prepared a memorandum on the subject which practically concedes the justice of the British representations. It admits, for example, that although "Savon de Windsor" may be held to be a genuine term, "Windsor Soap, London," indicates that the soap has been made in England. Such imitations cannot be reconciled with the spirit or the letter of the Madrid Convention of 1891, and the French Government have instructed the Customs administration to inform the French judicial authorities of the arrival of such fraudulent goods as soon as they are put on the market, so that they may be seized at once. And British manufacturers, whose trade has been injured, are recommended to approach the French Government with a view to the prosecution of the guilty parties by the State. The friendly action of the French Government will doubtless be appreciated by British traders, and it may be hoped that other countries, where these false trade descriptions are common, will take similar steps. It may be noted that there are numerous complaints under this head from Japan.

The Price of Wool.—Like wheat, the price of wool continues to rise, although in the case of wool the prices with which comparison is made were themselves very high. According to cablegrams from Australia, the prices ruling in the Colonial markets are above even the parity of the last London auctions. Since the opening of the season at Adelaide, some 70,000 bales have been sold in that city, Sydney, and Melbourne, and most of the wool has been bought for the Continent, more especially France. The situation is not unlike that which obtained in 1899, and which proved so disastrous to the trade. It is said in some quarters that there will be no increase in shipments from Australia this year, but it is difficult to reconcile this forecast with admitted facts as to the clip, and whether the event confirm it or not, the increase in shipments in the first three months of the present season has been very considerable. From July 1 to September 30 the shipments from Australian ports amounted to 162,000 bales. During the same period

the exports from New Zealand were 42,000 bales. Taken together, these exports exceed those for the corresponding period of last year by 46,000 bales, most of the increase coming from Australia. Since the closing of the list before the last London auctions, the arrivals of Colonial wool have amounted to 15,595 bales, of which 7,000 bales have been forwarded direct to consuming centres.

Textile Machinery.—The exports of British textile machinery in September, as shown by the Board of Trade returns, give evidence of further expansion. The total value for September this year is £652,307, as against £638,668 for September last year, and £457,254 for September, 1905. In the first nine months of the current year British textile manufacturers have shipped abroad to the value of £5,877,629, as compared with £4,810,730 for the corresponding period of last year, and £3,911,637 for the corresponding nine months in 1905. The increase in exports is most noticeable in the case of Germany—from £52,983 last year to £103,555; of "other countries in Europe" from £100,996 to £143,011; of Japan from £17,335 to £57,910; of countries in South America from £13,070 to £34,418.

Aluminium.—It is not surprising that the price of aluminium has fallen considerably of late having regard to the decline in the price of copper for which it is being largely substituted in the electrical industry, and also to the actual and nearing expiration of patents. The recent increase in the production of aluminium is remarkable, and it looks as if there will be even more rapid growth of output in the near future. The world's output of aluminium in 1899 was only 3,000 tons, in 1906 it had risen to 18,325, and some estimates for the present year double that amount. Most existing works have recently increased their output, and many new companies have been formed. The Aluminium Company of America have secured further rights over large bauxite deposits and have increased the capacity of the works at Niagara and at the Shawenegan Falls in Canada. In America the total production in 1906 was 6,500 tons as against 5,000 tons in 1905, and in Canada 2,700 as against 1,035 tons in the previous year. The British Aluminium Company are making large extensions in Scotland, and have obtained further extensive water rights at Stangfjord in Norway and Orisères in Switzerland; and two other English companies have been formed. The Aluminium Industrie Aktiengesellschaft, in addition to their works at Neuhausen and Lens, have just erected two large works at Wallis, and the two French Companies Froges expect to increase their output very largely this year, whilst the Société des Forces Matrices de l'Arve is about to devote 12,000 horse-power to the manufacture of aluminium, and the Société d'Electrochimie, 4,000. Various other projects for the production of aluminium are on foot in France, Belgium, and Italy.

Iron Ore Supplies.—It will be remembered that some years ago a company with a large capital and a directorate composed of leading ironmasters was formed to acquire large ore deposits in Norway, and by means of the Edison process, to convert the low-grade ore practically into non-phosphoric high-grade ore. The result of the experiment has been awaited with interest, since it is a matter of national importance, The rapid depletion of the iron-ore supplies is a subject of national concern, for the Spanish ore is not entirely suitable for the requirements of ironmasters, and the necessary supplies were not available elsewhere. It has long been known that in Norway there are vast deposits of iron ore but the quality of the ore is not naturally such as to make it available for commercial purposes. It is now many years since Mr. Edison first sought to devise the means whereby low grade ores could be made available for blast furnaces, and he invented a process whereby, as he claims, this object can be secured. This invention was secured by the company mentioned above with the object of applying it to the low grade ore in Norway, so as to make it available for British blast furnaces. By means of the Edison process, to quote from a description of it in the *Statist*, blocks of ore weighing anything up to five tons are dropped on to giant rollers, about five feet in diameter, faced by a series of bolted chilled iron plates, through which project rows of knobs diametrically opposed to each other, and about four inches in length, the rollers revolving at a speed of about 5,000 feet per minute. By means of a series of rollers the blocks are gradually reduced to powder, and by means of a magnet the concentrated ore, rich in iron, is separated from the remainder. Inasmuch, however, as it is impossible to use the ore in this form in blast furnaces, it is necessary to press the powder into briquettes. These briquettes, while being impervious to moisture, are at the same time sufficiently porous to allow the reducing gases in the blast furnaces to thoroughly penetrate them. It still remains to be seen whether the process can be brought to a successful commercial basis. Those directly interested in the experiment remain confident that it can be, but success has taken longer to achieve than was anticipated.

TEA.—The quantity of tea brought to auction in London from 1st July (including new season's Indian tea previously sold) as shown by the figures given in Messrs. Gow, Wilson, and Stanton's circular show a considerable shrinkage, so far as India is concerned, if compared with the corresponding figures of last season. Of Indian tea the quantity was 305,654 packages as against 340,237 last year, but the Ceylon sales increased as from 338,045 packages to 348,696 packages, whilst those from Java show the slight increase as between 26,481 packages and 27,315. The combined Indian and Ceylon teas taken in foreign and colonial markets during the first six months of this year show a slight advance upon the corresponding period last year.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

PRIZE FOR INDUSTRIAL HYGIENE.

The Council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a Gold Medal, or a prize of £20.

The medal, under the conditions laid down by the testator, is to be given "For any discovery, invention, or newly-devised method for obviating or materially diminishing any risk to life, limb, or health, incidental to any industrial occupation, and not previously capable of being so obviated or diminished by any known and practically available means."

Intending competitors should send in descriptions of their inventions not later than December 31st, 1907, to the Secretary of the Society of Arts, Adelphi, London, W.C.

Such descriptions may be sent in under the inventor's name, or under a motto, accompanied by a sealed envelope enclosing the name, as preferred.

The Judges will be appointed by the Council.

The Council reserve the right of withholding the prize or of awarding a smaller prize or smaller prizes, if in the opinion of the Judges nothing deserving the full award is sent in.

UNION OF INSTITUTIONS.

The following Institution has been received into Union since the last announcement :—

Wigan and District Mining and Technical College, Wigan.

COVERS FOR JOURNAL.

For the convenience of members wishing to bind their volumes of the *Journal*, cloth covers will be supplied, post free, for 1s. 6d. each, on application to the Secretary.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

DETERGENTS AND BLEACHING AGENTS USED IN LAUNDRY WORK.

By Prof. Herbert Jackson, F.I.C., F.C.S.

Lecture II.—Delivered April 22nd, 1907.

The use of alkali in some form or other is probably universal in laundries. Its employment for softening water has been dealt with already. A part of this lecture will be devoted to describing the common kinds of alkali, together with simple tests for recognising them and estimating their strength, and to a short consideration of their value as detergent agents.

The Table (p. 1102) gives the names and formulæ of the alkalies which are most likely to be met with.

The first column of numbers gives the parts of each alkali equivalent to any other one in power of neutralising an acid such as sulphuric acid, and the second set of numbers represents the percentage of what is frequently described as real alkali, *i.e.*, oxide of sodium (Na_2O). The equivalents do not represent the parts of alkalies of equal value in all other respects, as for instance for washing purposes, except in the case of strictly comparable forms of alkalies, such for example as the five different varieties of sodium carbonate, in four of which water enters into the composition. Here the equivalents truly represent the values, and whatever may be done by using 143 parts of the highest hydrate of sodium carbonate, viz., $Na_2CO_3 \cdot 10H_2O$, may be equally well effected by 53 parts of pure anhydrous Na_2CO_3 dissolved in the same volume of water. Strictly speaking, to make two such solutions perfectly comparable the water combined in the hydrated carbonate ought to be taken into account, but with the weak solutions employed in laundry practice this need not be considered at all.

The various alkalies can be distinguished from one another by simple tests such as the following, which are to be applied to cold solutions of the substances. Caustic soda gives a brown precipitate with a solution of silver nitrate which may be quite dilute. Caustic potash gives the same reaction, but a solution of this substance made acid with tartaric acid and stirred with a glass rod will give a white precipitate of potassium bitartrate while caustic soda will give no such precipitate. Silver nitrate will give precipitates with other alkalies, but no brown precipitate except possibly in the case of a warm rather dilute solution of borax which is easily distinguished by the test, to be given for this substance. Sodium carbonate and bicarbonate give brisk effervescence when treated with acid such as dilute sulphuric acid. They may be distinguished in solution by adding a solution of magnesium sulphate, which gives a white precipitate with sodium carbonate in the cold but none with sodium bicarbonate until the solution is heated. Borax can be identified as follows. Add to its solution dilute hydrochloric acid till blue litmus is just reddened, indicating that the acid is in slight excess. Dip a small strip of paper dyed with the yellow dye turmeric into this slightly acidified solution, and dry the paper by a gentle heat. A red colour will be formed, which is changed to dark green by a solution of caustic potash or soda. Turmeric paper goes brown with alkalies alone.

Solutions of silicate of soda, unless very dilute indeed, will quickly give a white gelatinous precipitate of hydrated silica if they are treated with a solution of ammonium chloride (sal ammoniac). No test for ammonia beyond the smell need be mentioned. It will be understood that the tests given are to be applied to simple solutions of the alkalies mentioned. It would lead to analytical details out of place here to enter into the methods of identification of the different alkalies in all the mixtures which may be offered to the launderer. But as it is advisable for him never to deal with alkalies except in their simple forms as recognised chemical substances, purchased under their proper names, and to make such mixtures as he may desire himself, the occasion for more elaborate testing will hardly arise. What is important is that he should be able to gauge the strengths of solutions of alkalies and to determine the values of the different varieties which he uses. For this purpose it is necessary to describe in some detail the methods of making standard solutions of acids and alkalies and of using them in analysis, together with the behaviour of certain substances employed to indicate whether a solution is acid, alkaline or neutral. The principle of such analysis is easily understood by a simple illustration. Suppose the launderer to have in his possession a sample of sodium carbonate known to be nearly pure and some dilute sulphuric acid. Then, without knowing anything of the strength of the acid, he can obtain a very fair idea of the value of some other sample of sodium carbonate as compared with the good one in the following manner. Let him dissolve a convenient weight of the good sample, say a quarter of an ounce, in distilled water, and from a graduated vessel add the dilute sulphuric acid little by little until the solution is shown to be just acid by its distinctly reddening blue

Name.	Formula.	Equivalent.	Na_2O per cent.
Caustic soda	$NaOH$	40	77·50
Sodium carbonate	Na_2CO_3	53	58·49
Crystal carbonate	Na_2CO_3 H_2O	62	50·00
Sodium sesquicarbonate	Na_2CO_3 $NaHCO_3$ $2N_2O$	75·3	41·15
Different hydrates of sodium carbonate	Na_2CO_3 $5H_2O$	98	31·63
	Na_2CO_3 $7H_2O$	116	26·72
Washing soda (soda crystals)	Na_2CO_3 $10H_2O$	143	21·67
Sodium bicarbonate	$NaHCO_3$	84	36·9
Sodium silicate (soluble glass)	(a solution of $Na_2Si_2O_5$ which varies in strength)		
Sodium silicate (Alkasil)	Na_2SiO_3 $9H_2O$	142	21·83
Borax	$Na_2B_4O_7$ $10H_2O$	191	16·23
Ammonia	(a solution of about 34°/0 real NH_3. The equivalent of NH_3 is 17)		
			K_2O per cent.
Caustic potash	KOH	56	83·92

litmus paper, noting the number of measures of sulphuric acid required to bring this about. If then he weighs a quarter of an ounce of the other sample and, proceeding in an exactly similar manner, finds that only three-quarters of the amount of the dilute sulphuric acid used in the first experiment are now required, it is clear that the sample has only 75 per cent. of the value of the good specimen of sodium carbonate. Although the strength of the acid was not known, the data had in reality been obtained for calculating it. If the test sample of sodium carbonate had been as pure as possible, the weighing and measuring accurate, and an indicator more suitable than litmus for use with cold solutions had been employed, a simple calculation would have given the actual value of the sulphuric acid. Expressed as an equation, the action of sulphuric acid on sodium carbonate is—

$$Na_2CO_3 + H_2SO_4 = Na_2SO_4 + H_2O + CO_2,$$

which represents the known fact that 106 parts of sodium carbonate and 98 parts of sulphuric acid (H_2SO_4) react on one another to produce neutral sodium sulphate, water and carbonic acid gas being formed at the same time. In the table of equivalents the number for Na_2CO_3 is given as half 106, or 53, so as to compare the molecule of Na_2CO_3, which contains two atoms of sodium (Na) with caustic soda and sodium bicarbonate, the molecules of which have only one atom of sodium in them. Halving the number 98, which is the molecular weight of sulphuric acid, gives the equivalent 49, representing the parts of this acid which will neutralise the number of parts of any of the alkalies given in the column of equivalents in the table. It follows, therefore, from what has been said that it is only necessary to be certain of the purity of a specimen of some one of the different alkalies, to be in a position to weigh and measure with reasonable accuracy, to know the proper indicators to use and the most convenient strengths of solutions of acids and alkalies to work with, in order to be able to obtain the values of any of the other alkalies or solutions of them with ease and considerable accuracy after a litttle practice. The best alkali to take as a standard is sodium carbonate. It can be obtained in a condition of great purity, and the only other substances likely to be present are a little water and perhaps a small amount of sodium bicarbonate. Before preparing a standard solution from it, about 30 grams should be heated to a dull red heat in a porcelain dish for about half an hour. This will expel the water and convert bicarbonate into carbonate. When cold, 26·5 grams are to be weighed out and transferred to a flask capable of holding 500 cubic centimetres of water, this volume being indicated by a mark on the neck of the flask. Distilled water is added in such a quantity as to make it convenient to shake up the contents, and, when all the carbonate has dissolved, water is added up to the mark. Such a solution contains sodium carbonate in the proportion of its equivalent, viz., 53 grams, in one litre. It is generally spoken of as a normal solution, and solutions of any alkalies or acids containing their equivalents in grams per litre would also be described as normal solutions of those alkalies or acids. They are convenient solutions to use, since a measure of any one of them is the chemical equivalent of an equal measure of any other. The standard solution of acid is made from strong sulphuric acid (oil of vitriol). This always contains a little water, so that it is not possible to obtain the right amount of it by direct weighing. The simplest plan to adopt is to measure off 30 cubic centimetres of the strong acid in a graduated vessel and to pour this carefully into about 200 cubic centimetres of distilled water in a beaker, washing out the vessel with a little more water. When the mixture is cold, it is transferred to a litre flask and distilled water is added up to the mark on the neck of the flask. The actual weight of acid (H_2SO_4) which is required in the litre is 49 grams, *i.e.*, the equivalent of sulphuric acid. Taking the specific gravity of the strong acid as 1·84, the 30 cubic centimetres would weigh appreciably more than 49 grams, but the solution is made stronger so that it can be diluted to normal strength after its value has been found, in the following manner. A convenient volume, say 20 cubic centimetres of the normal solution of sodium carbonate, is accurately measured into a small flask, and some of the solution of acid is added from a graduated vessel, such as a burette marked in cubic centimetres and tenths of cubic centimetres, until the alkali is exactly neutralised. Before adding the acid, a drop or two of a solution of methyl orange is put into the flask with the solution of sodium carbonate to act as an indicator. The colour will be yellow so long as the reaction is alkaline, and the acid is to be added until this colour just changes to a reddish pink, which indicates a very slight excess of acid. Very little indicator should be used, as the change is more noticeable with faint colours. (A

useful solution of methyl orange is made by dissolving a quarter of a gram of the solid substance in 250 cubic centimetres of dilute alcohol, about 30 per cent. strength. The solution will keep indefinitely.)

If the sulphuric acid solution had been normal, the reading of the burette would show that 20 cubic centimetres were required to neutralise the same volume of alkaline solution in the flask, but as the acid was purposely made too strong, less than this amount would certainly have been used from the burette, and a calculation from the result can be made to find the extent to which the solution must be diluted to bring it to normal strength. For example, suppose the reading of the burette had shown that 18 cubic centimetres had been added to the 20 cubic centimetres of normal sodium carbonate, and were therefore equal to them in strength. Then $\frac{18 \times 1000}{20} = 900$ cubic centimetres of the acid are equal to 1,000 cubic centimetres, *i.e.*, one litre of the standard. The dilution, therefore, of 900 cubic centimetres of the acid to one litre with distilled water, will bring it to normal, that is to a strength of 49 grams of H_2SO_4 per litre. For most purposes a solution of one-tenth, this strength spoken of as a decinormal or $\frac{N}{10}$ solution, is more generally employed and is made readily from the normal acid by diluting 100 cubic centimetres of the latter with distilled water to one litre. Each cubic centimetre of this weaker acid contains ·0049 grams of H_2SO_4, and is capable of neutralising the one ten-thousandth part of each of the equivalents given in the table of alkalies, using methyl orange as the indicator. Whether the stronger or weaker acid is used will depend on the accuracy with which samples of alkali can be weighed out. If the balance available is a rough one, only capable of turning with a centigram, the normal acid should be used. For example, suppose it is desired to value a certain sample of sodium carbonate. If the normal acid is to be employed, weigh out 10 grams of the sample and dissolve them in distilled water, making the solution up to 250 cubic centimetres. Measure 25 cubic centimetres into a flask and add normal acid from a burette until neutrality is indicated. Let it be supposed that 12 cubic centimetres are required. Then as each cubic centimetre of normal acid is capable of neutralising ·053 grams (*i.e.*, the one-thousandth part of the equivalent) of sodium carbonate $12 \times \cdot053 = \cdot636$ is the amount of Na_2CO_3 present in the 25 cubic centimetres tested or 6·36 grams of real Na_2CO_3 in the 10 grams which were dissolved, *i.e.*, 63·6 per cent., the rest being probably water. With decinormal acid 1 gram of the sample can be dissolved and the solution made up to 250 cubic centimetres, the subsequent procedure being the same, and the calculation made for the equivalent of the weaker acid. One of the advantages of using the weaker acid is that a litre of normal acid once made carefully and kept in a stoppered bottle will last a long time as the source of several litres of the decinormal acid, and if the balance used is sufficiently delicate results of considerable accuracy can be obtained, while several determinations can be made, not only of samples of alkali, but of the alkalies in soaps, and in any of the solutions used in the laundry, without the fear of using up a standard acid which had taken some time to prepare. It is impossible in the time which can be devoted to this part of the subject to give details of all the applications of standard acids and alkalies which can be made in a laundry, but before passing on to the action of alkalies as detergent agents, some reference must be made to another useful indicator, viz., a solution of phenol phthalein and to the well known litmus. When sulphuric acid acts on sodium carbonate, borate, or silicate, the acids—carbonic, boracic and silicic are liberated. None of these has practically any effect on methyl orange, and therefore all the alkali considered as Na_2O present in the compounds mentioned, is used up in neutralising the sulphuric acid with which they may be treated. In the case of litmus, such a weak acid as carbonic acid has a partial effect, and consequently this indicator can only be used to give good results with alkaline carbonates if the carbonic acid as it is liberated is expelled by boiling. Litmus is not suitable as an indicator with borates and silicates, but it may be used with caustic alkalies. Phenol phthalein is affected by carbonic acid to such an extent that it shows no reaction with solutions of sodium bicarbonate, and this property makes it a very useful indicator when it is required to determine the constitution of mixtures of caustic soda and sodium carbonate, or of the latter with sodium bicarbonate. This use of phenol phthalein is best shown by taking two examples. Suppose that it is desired to find the amount of carbonate in a sample of caustic soda. Weigh out one gram of the sample and make up a solution of it, in

distilled water, to 250 cubic centimetres. Find the volume of decinormal acid required to neutralise 25 cubic centimetres of this solution, using methyl orange as the indicator. As an instance let this volume of acid be 22 cubic centimetres. Then do the same experiment but with phenol phthalein as the indicator. A smaller volume of sulphuric acid will be found to be required if any carbonate is present. As an example let this volume be 20 cubic centimetres. The method of calculating is as follows. With phenol phthalein all the caustic soda is shown, but only half the sodium carbonate, since when half of it has been neutralised the sodium carbonate has become sodium bicarbonate, to which phenol phthalein does not respond. Therefore double the difference between the volumes of acid used with methyl orange and phenol phthalein represents the amount of acid required for the sodium carbonate present. Hence in the instance taken the volume of $\frac{N}{10}$ acid required for the Na_2CO_3 present in 25 cubic centimetres of the solution is double the difference between 22 and 20, that is to say 4 cubic centimetres. As 1 cubic centimetre of $\frac{N}{10}$ acid is equivalent to ·0053 grams Na_2CO_3, the amount of this substance present in ·1 gram of the sample is $\cdot 0053 \times 4 = \cdot 0212$ grams or 21·2 per cent. The percentage of caustic soda (NaOH) is found from the amount of acid used, which has yet to be accounted for in the determination with methyl orange as indicator. This is 22-4 or 18 cubic centimetres, which were therefore used up to neutralise the NaOH in the 25 cubic centimetres of solution taken. From the table of equivalents it is seen that 1 cubic centimetre of $\frac{N}{10}$ acid neutralises ·004 grams caustic soda. Hence the amount of NaOH present in ·1 gram of the sample is $18 \times \cdot 004 = \cdot 072$ grams or 72 per cent., leaving 6·8 per cent. of the sample to be accounted for as water, or possibly neutral salts. The two determinations, one using methyl orange and one with phenol phthalein, are made in the same way for mixtures of sodium carbonate and bicarbonate, and again the method of calculation may be shown by an example. One gram of a sample of sodium carbonate which had been exposed to the air and was suspected to contain bicarbonate was dissolved in water and the solution made up to 250 cubic centimetres. Using methyl orange as the indicator, 25 cubic centimetres of the alkaline solution required 15 cubic centimetres of $\frac{N}{10}$ sulphuric acid for complete neutralisation. With phenol phthalein the volume of acid needed was 6·5 cubic centimetres. As only half the sodium carbonate and none of the bicarbonate is shown with phenol phthalein, the volume of acid used with this indicator was doubled, giving, therefore, $\cdot 0053 \times 13 = \cdot 0689$ grams of Na_2CO_3 as the amount present in ·1 gram of the sample, that is say 68·9 per cent. The rest of the acid, viz., $15 - 13 = 2$ cubic centimetres went to neutralise the sodium bicarbonate. From the table of equivalents 1 cubic centimetre of $\frac{N}{10}$ sulphuric acid neutralises ·0084 grams of sodium bicarbonate ($NaHCO_3$). Therefore, the amount of this present in ·1 gram of the sample was $\cdot 0084 \times 2 = \cdot 0168$ grams, $NaHCO_3$, or 16·8 per cent., leaving 14·3 per cent. of water in the sample. (A solution of phenol phthalein may be made by dissolving 1 gram of the solid in a little strong alcohol, and making up the solution to 250 cubic centimetres with alcohol of about 40 per cent. strength. The solution does not alter on being kept, and a few drops only are needed each time it is used as an indicator. The alcohol used should of course be free from any appreciable amount of acid.) The subject of determining the values of alkalies has been dealt with somewhat fully because experience shows that there is no greater and more fruitful source of trouble than the indiscriminate use of alkaline solutions for washing purposes. It is of very great importance that the launderer should be able to ascertain for himself the strength of the alkalies which he uses and not have to depend on statements made in advertisements or otherwise.

In some instances it is probable that one of the chief reasons for employing alkali in one form or another is to effect a saving in the consumption of the more expensive detergent soap. The action of alkali to soften water has been dealt with in the first lecture. Where a water is not softened in bulk before being used for washing, it is clear that some alkali must be used to prevent an unnecessary and foolish waste of soap, but the use of a large amount over and above what is required for this purpose is undoubtedly to be condemned. It is frequently stated that one of the effects of alkali is to saponify the fats and grease which are always present to some extent in the various articles sent to a laundry to be washed. Direct experiment shows that the extent of saponification brought about by such an alkali as sodium carbonate even in the greatest strength in which it is probably ever used in laundry work, is very slight indeed. Where

free fatty acids occur in clothing, &c., the alkali does neutralise them practically completely, but so far as fats are concerned its action appears to be dependent on the property which most alkalies have when their solutions are shaken with fats or oils, of producing emulsions consisting of separated globules of fat in a fine state of division. It seems very probable that in this particular instance of emulsification some chemical action does take place to a small extent in the direction of saponification, and that this slight action is necessary for the production of a successful emulsion. Oils or greases which are free from all saponifiable matter will not yield any emulsions when shaken up with plain aqueous solutions of alkalies, but the addition of a little saponifiable oil or fat makes it possible to hold a fair amount of the unsaponifiable grease in a mechanical state of emulsion lasting long enough to allow of its being washed away. With regard to the relative values of different alkalies as emulsifying agents, experiments with caustic soda, ammonia, sodium carbonate, borax and sodium bicarbonate show that so far as the first four are concerned, and dealing with commonly occurring fats and oils, there is practically nothing to choose between them if an equivalent quantity of each is taken.

It might well be expected that caustic soda on account of its greater activity as a saponifying agent would be superior to the other alkalies, but emulsions made with it, and with equivalent quantities of sodium carbonate, borax and ammonia, and the same amount of fats and oils, show no practical difference even after being kept for some months. An emulsion made with borax is the most lasting of all. Sodium bicarbonate can scarcely be called an emulsifying agent. Its power in this respect is less than one-fiftieth of that possessed by an equivalent quantity of any of the other four alkalies mentioned. It is not possible to give any exact data of the amounts of fat or oil held in a state of emulsion by alkalies, as the conditions of experiments vary, and some kinds of fat emulsify more easily and completely than others, but as some guide it may be mentioned that a variety of experiments show that one part of caustic soda, or the chemical equivalent of the other alkalies described as good emulsifying agents, will hold about forty parts of the average kinds of grease and oil met with in a state of emulsion lasting a considerable time, even when the actual strength of the alkaline solution is not greater than about ·05 per cent. The emulsifying power of soap is also considerable, but it is increased materially by the addition of more alkali. Another reason for using some alkali in connection with soaps, is to be found in the tendency, which is noticed in the case of some soaps, to the formation of insoluble or sparingly soluble acid soaps, as a result of the action of water. These may give rise to trouble in the form of spots and marks, which frequently do not show up until the washed article is finished and ironed. The addition of a little alkali, such as sodium carbonate, along with the soap, when the latter is being dissolved, will often prevent the formation of such acid soaps although, when once formed, a great deal of alkali may fail to dissolve them. Hence the alkali should be added with the soap, and not after this has dissolved and so had time to be affected by water.

It will be gathered from what has been said, that for much of the ordinary work which has to be done in a laundry the use of some alkali is practically a necessity. The questions of importance which arise, therefore, are which alkali to use, and in what strength to use it, so as to avoid the danger of damaging the articles to be washed.

In answer to the first question, it may be said at once that the use of caustic soda is to be condemned. No launderer of experience would, of course, think of treating woollen goods with any form of free alkali, but as examples have been found in actual practice of damage done to woollen materials which could only be ascribed to the action of alkalies, it may be as well to point out the various changes brought about by the action of even so dilute a solution of caustic soda as one containing ·05 per cent. of NaOH. The solvent action of alkalies on wool will be referred to again in the next lecture, but for the present it will be of interest to consider the extent of the action of caustic soda in comparison with that of sodium carbonate, borax, and ammonia.

A large number of experiments have been made in this direction, the details of which would occupy too much time to give even in outline, but the general conclusion arrived at may be stated briefly and illustrated with photo-micrographs of specimens of wool fibre before and after treatment with alkalies. As anything like a 1 per cent. solution of caustic soda at a temperature of 32° Cent. (90° Fah.) allowed to act on wool for some time will completely disintegrate and destroy it for all practical purposes, reference will only be made

to the action of a solution of ·05 per cent. strength at the same temperature. This is found to be practically at least twenty times as great in rendering woollen fabric harsh, brittle, and shrunken up as the action of an equivalent

FIG. 1.

solution of sodium carbonate. To illustrate this Figures 1, 2, 3, and 4 are given. Fig. 1 shows a fibre from flannel before treatment. Fig. 2 a fibre of a portion of the same flannel after treatment at 90° Fah., with ·05 per cent. solution of caustic soda. Fig. 3 a fibre from

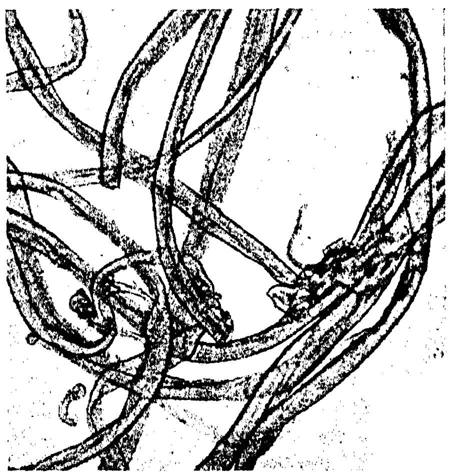
FIG. 2.

another portion after treatment with a solution of sodium carbonate containing 1·3 per cent. of Na_2CO_3, *i.e.*, twenty times the equivalent of ·05 per cent. NaOH. The magnification for these three was 300 diameters. Fig. 4 is a photograph of a few fibres from a small, hard, and felted piece from the same portion of flannel as that used for Fig. 3. The magnification in this case was 120 diameters to show the general twisting and breaking up resulting from the action of the alkali.

FIG. 3.

It is not suggested that all the fibres in the pieces of treated flannel were as broken and damaged as those shown. They have been chosen from a number of similar ones to show what is to be considered as the effect which would follow the prolonged or repeated action

FIG. 4.



of alkalies of the strengths mentioned, and it is not intended to convey the idea that every piece of woollen material rendered harsh and unpleasant to the touch, and with the natural spring destroyed by the use of alkali would

necessarily show such extensive destruction of the fibre. Sooner or later, however, a very similar result would follow as the weakened material was subjected to ordinary wear and tear.

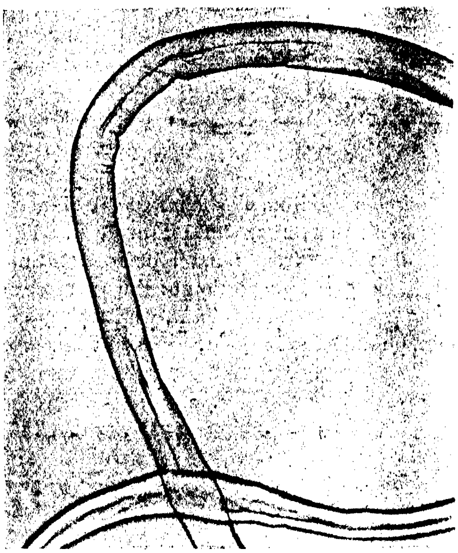
Solutions of borax (4·6 per cent. $Na_2B_4O_7 . 10H_2O$) and ammonia (·42 per cent. real NH_3) equivalent in strength to the 1·3 per cent. solution of sodium carbonate, and allowed to act on wool in the same manner gave results showing decidedly less indication of destruction to the fibre, but the wool was rendered harsh and impoverished. Caustic potash has at least as much effect on wool as caustic soda. It has been said that no free alkali of any kind should be used in washing woollen articles since sufficient neutral soap, given the time to act, will cleanse even very greasy material of this nature, but should the occasion arise when a little alkali appears to be a necessity, experiments show that weak solutions of borax of about ·5 per cent. strength will materially assist in the removal of grease and greasy stains with the least damaging effect on the wool fibre. A solution of ammonia containing ·05 per cent. of real NH_3 is about equivalent to the borax solution and has much the same effect.

Silk is affected by alkalies in much the same way as wool, and although the effect on the fibres is not so apparent under the microscope, they are much weakened and left in a condition which in time developes into one of general disintegration. Borax again has the least effect, but ammonia unless quite weak soon deteriorates silk.

The action of alkalies on cotton and linen is well known to be very much less harmful than that on wool and silk. In the process of mercerisation, cotton is treated with a strong cold solution of caustic soda, the effect being to form a compound of the cellulose with the alkali, and to shrink and thicken the fibre, which is changed from a flat riband into a cylindrical form. The swollen appearance may be seen in Fig. 5, which is a photo-micrograph of a treated fibre.

The alkali compound of the cellulose is unstable, and is changed by water to a cellulose hydrate, the alkali being dissolved in the water. This change does not seem to be accompanied by any visible disorganisation of the fibre, which is found to have gained in tensile strength. It might appear, therefore, at first sight, as if no danger need be apprehended from the use of alkali in washing cotton goods, but it must be remembered that there is a great difference between a single treatment with alkali in the cold followed by a thorough washing, and the constant use of hot solutions of an alkali such as sodium carbonate. Even supposing the solution used to be a dilute one, there is the danger, through insufficient rinsing, of concentration of the alkali on drying, and of its action at a high temperature in any subsequent process of ironing. Direct experiment, and the examination for alkali of several examples of washed and finished articles, such as table linen and cotton sheets, &c., have proved that this danger is a very real one, and that the use of much alkali will inevitably weaken and disin-

FIG. 5.

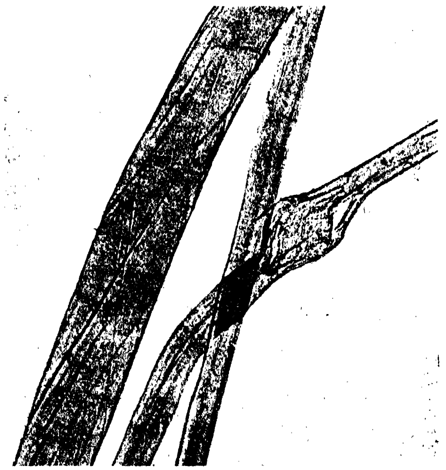


tegrate cotton and linen in a much shorter time than that in which anything like the same change could be brought about by the action of soap and water alone. The effect of alkali on linen fibre can be made more apparent than that on the fibre of cotton.

The accompanying Fig. 6 represents fibres of linen, in the broadest of which distinct oblique markings are visible. These were not to be seen before the fibre was affected by alkali. The treatment was carried out under the microscope, the fibre being soaked in hot alkaline solution, washed and dried, and the process repeated six times. The markings were observed to increase in extent and distinctness as the treatment progressed, and may, therefore, be considered to be indications of approaching disintegration of this fibre.

Another and cogent reason for avoiding the use of strong alkaline solutions in washing cotton or linen articles is that the production of a bad colour is almost certain to follow. Experiments made with different pieces of the same samples of linen and cotton washed about ten times in plain neutral soap solution, and in solutions of soap with varying strengths of alkali, showed that a distinct difference in colour could be seen even when so dilute a solution of sodium carbonate as one containing ·1 per cent. of Na_2CO_3 was used. To advise that no alkali should be employed in washing linen and cotton would be to offer a counsel of perfection which it would be unreasonable to hope could possibly be followed in view of the amount of grease and dirt which is so often present in articles sent to a laundry. What may reasonably be said is that the quantity of alkali used is often out of all proportion to that required, and that the very strength of the solutions defeats the object of the launderer, not only by discolouring the goods, but frequently also by preventing the removal of very finely divided dirt. The character of the work in laundries varies so much that it is impossible to make any very definite statement as to the strength of alkali to be used. For the general average of linen and cotton articles a ·1 per cent. solution of sodium carbonate Na_2CO_3 (one pound to 100 gallons of water) may be considered to represent the superior limit of strength, and a ·05 per cent. solution will certainly give better results with less danger to the material, but will require the expenditure of more soap and a longer time.

FIG. 6.



It may not be out of place here to repeat the advice that every one who has to direct the processes in a laundry should familiarise himself with the methods and practice of determining the strength of alkaline solutions. It has happened on some occasions that a change has been made from an hydrated form of sodium carbonate to anhydrous sodium carbonate without any alteration in the weight used for the same volume of water. Reference to the table of alkalies and their equivalents, will show that this may very well have meant unintentionally doubling the amount of real alkali dissolved with, no doubt, some saving in soap and probably time, but with the accompanying trouble of bad colour and deteriorated material. The use of caustic soda, instead of sodium carbonate, for washing linen and cotton, is to be condemned. It is true that, in very careful hands, the use of small amounts of caustic soda has not appeared to be open to any reasonable objection, but it is doubtful in such cases whether caustic soda was really the agent employed in the actual washing. In three instances in which the washing fluid was examined, it was shown that the amount of available carbonic acid present in the water was sufficient to convert practically the whole of the caustic soda added into sodium carbonate which was, therefore, the form of alkali to the action of which the articles were in reality subjected. The addition of more caustic soda, so as to use some in the free state, was soon followed by the appearance of a brown colour on some of the linen articles washed. As a rule, linen shows the brown stains due to alkali in a much shorter time than cotton.

The subject of bleaching agents is of considerable importance and interest to those engaged in laundry practice. It is, of course, to be understood that bleaching by special agents should never form part of the ordinary process of washing. The practice of always putting a certain proportion of bleach into the washing fluids used to clean white linen and cotton goods, with a view to improving their colour, is bad, and against the interests alike of the launderer and the owners of the articles. It is easy to give the advice that no quick bleaching agents should ever be employed under any conditions, but so long as the launderer is asked and expected to remove obstinate stains in one washing, and to leave no visible trace of them, he must have recourse to some agent other than the usual detergents. Many stains can undoubtedly be removed, if

sufficient time and individual attention be given to them, by the use of soap and water, and a little mild alkali, such as borax, but it is practically out of the question to expect this to be done in a laundry in which a large amount of work has to be completed in a specified time. If bleaching in some cases is, therefore, practically demanded of the launderer, it is important that the nature of the bleaching agents used, and the best strengths of their solutions should be fully understood, so as to avoid as far as possible any serious damage to the articles bleached.

The bleaching agents, the relative values of which have been tried, are given in the following list:—

Light.

Chlorinated lime.

Chlorinated soda.

Hydrogen peroxide.

Hydrogen peroxide with very dilute ammonia.

Potassium permanganate, followed by sulphurous acid.

Potassium permanganate, followed by oxalic acid and a little very dilute sulphuric acid or acetic acid.

Potassium permanganate, followed by hydrogen peroxide and very dilute sulphuric acid, or acetic acid.

Sodium peroxide alone, or with magnesium sulphate.

Electrolytic bleach.

Soaping and exposing on grass throughout dewy nights.

Ozone.

Sulphurous acid.

Potassium metabisulphite.

Sodium hydrosulphite.

Titanous chloride.

Stannous chloride.

To these may be added oxalic acid, if its action in removing iron stains can be spoken of as bleaching.

The eleven substances following Light on this list, owe their bleaching properties to the readiness with which they add oxygen to many colouring matters, the fully oxidised compounds of which are practically colourless. Sulphurous acid, and those following it, act as reducing agents, that is, they remove oxygen from certain colouring matters, the de-oxidised products which result, being either colourless, or much less highly coloured than the original substances. As a rule, bleaching by reducing agents is less permanent than that accompanying further oxidation, the colour returning to some extent on exposure to light, or often when the bleached material is treated with soap or alkalies. The action of light is to favour the absorption of oxygen from the air, and to restore the reduced compound to its original condition. A still longer exposure to sunlight, by promoting further absorption of oxygen, will frequently bring about a second bleaching in a manner analogous to that in which an oxidising substance, such as hydrogen peroxide, acts. Bleaching by light is the most desirable of all processes and causes the least possible deterioration of fabrics. It is unfortunately impracticable in most towns, besides being a very slow process in the case of refractory stains. The agent which is most usually employed is chlorinated lime or soda. The active agent is chlorine in a state capable of effecting oxidation in the presence of water. A fair specimen of chlorinated lime should contain from 30 to 35 per cent. of such available chlorine. Either in the form of the lime or soda compound this bleaching agent is wholly inapplicable in laundry work to woollen or silk articles, the fibres of which are attacked by chlorine and rendered harsh and brittle. Its use is restricted to the bleaching of linen or cotton, the cellulose of which is, however, by no means unaffected by chlorine although possessing much less affinity for this oxidising agent than wool. It is necessary, therefore, to exercise great care in the employment of a chlorine bleach, and the following directions are given as a suggestion for making and using either chlorinated lime or soda solutions in the strongest form which experience shows it is reasonably safe to adopt.

Six lbs. of chlorinated lime are to be well mixed with 100 gallons of water and the mixture allowed to settle. The clear liquid only is to be used, and it will be found to contain from ·14 to ·2 per cent. of available chlorine, according to the richness in chlorine of the lime compound dissolved.

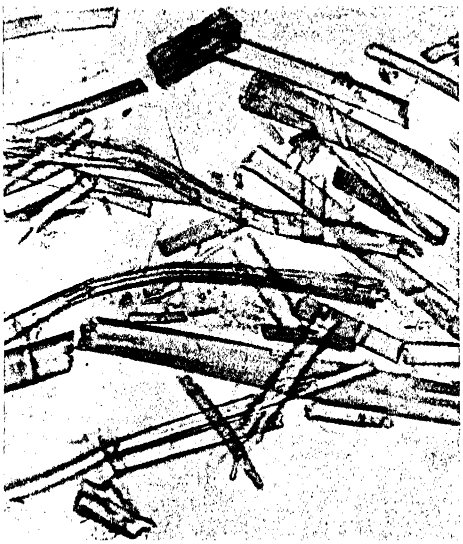
For a solution of chlorinated soda, 5 lbs. of chlorinated lime are to be thoroughly mixed with 6 gallons of water, and to this mixture are to be added 4 gallons of water in which $6\frac{3}{4}$ lbs. of anhydrous sodium carbonate (Na_2CO_3) have been dissolved. The whole is to be well stirred up and then allowed to settle. For use one pint of the clear fluid is to be diluted with water to one gallon. This diluted solution will contain practically the same percentage of available chlorine as the solution made from chlorinated lime.

Whichever solution is used, the fabric after having been steeped in it should be trans-

ferred without rinsing to a bath of either a solution of acetic acid containing about 2·5 per cent. of glacial acetic acid, or a solution of sulphuric acid containing not more than ·8 per cent. of pure acid (H_2SO_4), *i.e.*, 1° Twaddell (1·005 specific gravity).

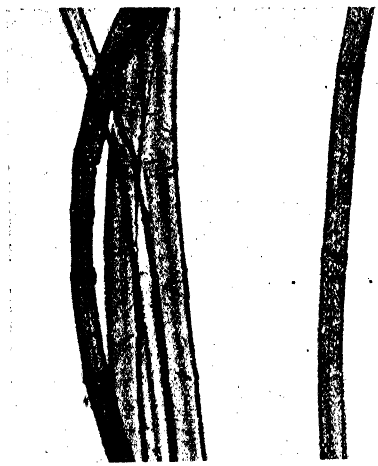
In all instances the solution of acetic acid is to be preferred. The main bleaching agent in this case is hypochlorous acid which is liberated by the acetic acid from calcium or sodium hypochlorite present in the solution of chlorinated lime or soda, calcium or sodium acetate being formed at the same time. The hpyochlorous acid (HOCl) bleaches by parting with its oxygen and becoming

FIG. 7.



thereby converted into hydrochloric acid, HCl. This acid in turn reacts on either calcium or sodium acetate to form the chlorides of these metals, liberating acetic acid, which, therefore, is finally left as the only free acid present with the fabric. Thorough rinsing should follow the bath of acid, but the advantage of using acetic acid lies in the fact that should traces of this acid be left in the fabric it will have little, if any, bad effect on the fibres in the subsequent processes of drying and ironing. When a bath of sulphuric acid is used instead, the principal bleaching agent is free chlorine, which becomes converted in the course of its reaction on the colouring matter into hydrochloric acid. Part of the sulphuric acid forms calcium or sodium sulphate, but some will be left in the free state along with the hydrochloric acid. Very complete rinsing is therefore necessary, and it is advisable to make sure of the absence of any possible free acid either by adding a little alkali to the last rinsing but one, or else by washing the articles once again with soap in the usual manner. It has been found that much of the damage done by bleaching is often attributable to the free acid left in the fabric. However dilute the solution may be, the acid becomes concentrated on drying and heating, with the result that the fibres of linen or cotton which are rapidly affected by free acid become disorganised and break up into small pieces. Linen fibre, from its difference in structure, is

FIG. 8.



more easily affected by chlorinated lime or soda solutions and other oxidising agents than cotton.

The general effect of badly conducted bleaching is illustrated in Fig. 7, which is a photo-micrograph of disintegrated fibres of linen seen under a magnification of 250 diameters.

Fig. 8 shows some fibres of the same piece of linen before treatment. The transverse markings which give the fibres somewhat the appearances of bamboo canes vary in different specimens of linen fibre. They are not visible in the actual bast fibres of the plant, but become apparent after the process of manufacture into flax. It is principally at these markings or nodes that the breaks occur when linen is subjected to injudicious chemical treatment, but the fibres are also seen to split longitudinally.

Fig. 9 illustrates the appearance under the microscope of mechanical injury done to linen

fibre by the rough treatment which it often receives during the preparation of the fabric.

Fig. 10 is a photo-micrograph of a small piece of cotton fibre damaged by bleaching and showing one end just ready to break off.

With reference to Fig. 9, it may be mentioned that mechanical injuries of the kind shown do not appear in old linen which is known to have been in use for many years to anything like the same extent as is to be seen in many examples of modern linen. Such injuries naturally weaken the fibres considerably, and experiments have shown that specimens of well-preserved old linen will still stand without injury a treatment which reveals the undoubted weakness and structural disorganisation of the fibres of many

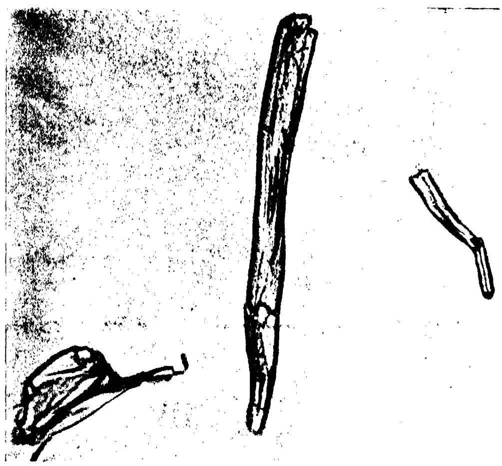
FIG. 9.

samples of new linen of recent manufacture. Bleaching by potassium permanganate followed by sulphurous acid was first introduced by Professor W. N. Hartley in 1869 as a process specially applicable in the preparation of white linen. When used with care the effect on the fibres of linen and cotton is very slight and the process may also be adapted to the bleaching of stains of an organic and easily oxidisable nature on wool and silk if precautions are taken to avoid strong solutions of the ingredients. The following directions are given for making and using the strongest solutions which should ever be used. Steep the fabric in a solution containing one ounce of potassium permanganate ($K_2Mn_2O_8$) dissolved in one gallon of water until a definite brown colour has been produced. Then wash thoroughly in water.

Place the browned fabric next in a solution containing one lb. of sodium sulphite ($N_2SO_3 \cdot 7H_2O$) dissolved in one gallon of water to which three fluid ounces of sulphuric acid (oil of vitriol of specific gravity about 1·8) have been added. (This gives a solution containing about 3 per cent of sulphurous acid, H_2SO_3). Leave the fabric in it until all brown colour has disappeared. Rinse thoroughly in water and give a final wash with the soap in the ordinary way.

Linen and cotton do not assume a brown colour so readily as wool and silk, and require, therefore, longer steeping in the permanganate solution. The strengths of the solutions may with advantage be about half those given when wool or silk are to be treated. The action of the permanganate is, however, selective, and an organic stain on linen or cotton will become dark brown long before the rest

FIG. 10.



of the fabric is much coloured. When the stain has assumed a dark colour there is no object in continuing the steeping in the permanganate solution. At no stage of the bleaching process should the fabric be allowed to dry. The brown colour is due to the deposition of hydrated manganese dioxide formed from the permanganate when the latter gives up part of its oxygen to the organic matter of the fabric or the stains. The action of the sulphurous acid consists in the removal of part of the oxygen from manganese dioxide with the formation of sulphuric acid, which remains in combination with the lower oxide of manganese as soluble manganese sulphate. The thorough washing advised is necessary because if sulphurous acid were left in the fabric some of it would be oxidised by the air to sulphuric acid, and besides there is sure to be a certain small amount of sulphuric acid free in the solution. It will be

seen that the fabric is alternately exposed to the oxidising influence of potassium permanganate, and to the de-oxidising or reducing action of sulphurous acid. In the case of linen or cotton goods this acid is quite a suitable agent to employ to remove the brown manganese dioxide, so long as it is completely washed out afterwards, but sometimes, and even after thorough washing, wool and silk treated with sulphurous acid will acquire a yellow tint in a little time. For these fabrics, it is better to substitute for sulphurous acid in the process a weak solution of hydrogen peroxide acidified with a little acetic acid. A solution of oxalic acid, containing a little acetic acid, will also remove the brown colour, but it requires a longer time to act, and in the case of very marked stains, some difficulty may be experienced in getting rid of the last traces of brown colour.

When a stain is a very bad one, it is not advisable to leave the fabric for a long time in the solution of permanganate in the hope that prolonged oxidation will remove it. It is far better to repeat the whole process, as in this way obstinate stains, such as the marks of a scorch, can be removed with the least possible damage to the fibre.

If the precautions mentioned are carefully observed, this method of bleaching will be found to be a very useful one in laundry practice. It is, perhaps, a little more troublesome to apply than a chlorine process, and the smell of sulphurous acid is somewhat choking, but the chance of damaging fabrics is very much less, while the solution of sulphurous acid may be diluted and the browned fabric left in it a longer time to decolourise.

Of the other bleaching agents mentioned in the list, hydrogen peroxide, sodium peroxide, and sodium hydrosulphite are probably the only ones of any special interest. There is reason to believe that both in the bleaching which occurs with light and in that which is observed to have taken place after exposure of soaped articles on grass during nights of heavy dews or white frosts, or on the surface of snow, hydrogen peroxide plays an important part. This substance is generally obtained in the form of a solution in water described as a 10 or 20 volume solution which will often be found to be slightly acid in reaction. A 10 volume solution means one which would give a volume of oxygen 10 times greater than the volume of liquid from which it was obtained if all the available oxygen in the hydrogen peroxide (H_2O_2) present were expelled. Such a solution contains about 3 per cent. of real H_2O_2. It can be obtained of higher concentration than that represented by 20 vols., but as with increased strength the solution as commercially prepared becomes more unstable it is not advisable to keep any quantity of greater strength than the 20 volume solution. Perfectly pure H_2O_2 in solution is remarkably stable but when impure it decomposes into water and oxygen. This change is much accelerated by the addition of alkalies. Traces of free acids on the contrary retard the decomposition and enable solutions of the strengths mentioned to be kept practically without any great alteration for a considerable time.

As a bleaching agent, hydrogen peroxide is slow in action. For use with wool or silk, the 10 volume solution may be diluted 10 times, and its action will be hastened if enough very dilute ammonia is added to make the liquid faintly alkaline. The articles to be bleached may be left in this diluted solution for from half an hour to one hour. They should then be hung up to dry somewhat slowly in the air and in as much light as it is possible to expose them to. If the bleaching is not satisfactory, it is better to repeat the soaking and drying, as in this way more effectual bleaching is obtained than by leaving the articles soaking for a long time in the peroxide solution.

Sodium peroxide (Na_2O_2) is sometimes used as a substitute for hydrogen peroxide or as a source of this substance. If sodium peroxide is mixed with a little water there is a brisk disengagement of oxygen with the formation of caustic soda, but if it is added to a considerable volume of cold water, it dissolves without noticeable evolution of oxygen, and the solution behaves as an alkaline solution of hydrogen peroxide. It is doubtful whether the use of sodium peroxide offers any advantage to the launderer, but should he wish to employ it, a solution containing ·7 per cent. of Na_2O_2 (about 500 grains to the gallon) will furnish about the same amount of available oxygen as the dilute hydrogen peroxide mentioned above. It must, however, be specially remembered that such a solution will be alkaline to an extent equal to one of caustic soda, containing almost the same amount of NaOH, viz., ·7 per cent, and it has been stated already that anything like such a strength of caustic alkali would seriously affect wool and silk. To overcome this difficulty, magnesium sulphate is added, so as to form sodium sulphate, and

comparatively innocuous magnesium hydrate and possibly a little peroxide. If magnesium sulphate ($MgSO_4 \cdot 7H_2O$) is added to an amount which is three times that of the sodium peroxide, the liquid will be practically free from any caustic soda. Another way to avoid any caustic soda and to produce a solution of hydrogen peroxide ready for bleaching, is to add dilute acid to the ·7 per cent. solution of Na_2O_2 until it is nearly neutralised, or what is safer and easier to just acidify the solution, and then to render it faintly alkaline with very dilute ammonia.

Sodium hydrosulphite ($Na_2S_2O_4$) has been mentioned on account of its value as a bleaching agent for one purpose specially. Among the blues which are used to correct any yellow tinge on washed articles methylene blue has a marked affinity for cellulose, which it dyes with a colour which is very fast to most bleaching agents, and if the blueing has been overdone it is very difficult to remove it with the ordinary bleach without damage to the fabric. A dilute solution of sodium hydrosulphite (about 1 per cent. will suffice) will rapidly whiten the dyed material. The colour will return on rinsing and exposing to air, but to an extent only of about 50 per cent. of the original depth of colour. A second or third immersion in the solution of sodium hydrosulphite, with good rinsing in between, will probably bring the colour to the right hue without any fear of affecting the fibre prejudicially if thorough rinsing follows the bleaching.

In conclusion, it may be permitted to remind the launderer once again that bleaching of any kind should be resorted to as seldom as possible, and to suggest that he might well make it his business to educate his public to understand the impossibility of removing either bad stains, or very excessive dirt, in the time given to him, without employing a treatment rather more drastic in character than that which is involved in the use of soap and water alone.

MOHAIR INDUSTRY OF KONIA.

The following report on the mohair goats of the Konia district, drawn up by the Acting British Vice-Consul there (Capt. Doughty Wylie) is taken from the *Board of Trade Journal*:—

By the last returns of the "agnam" tax for 1906, there were then in Konia province 566,100 mohair goats alive, not counting this year's kids. Of these, the severe winter and spring of 1906 and 1907 have killed about 30 per cent. Of this loss, it is estimated that 15 per cent. were males, 40 per cent. females, and the rest yearlings. They died from wet, weakness induced by starvation, and from abortion. However, about the same quantity of mohair is on the market this year as last year, most of the dead goats having been clipped after death. The general quantity of mohair from the Konia market is about 200,000 okes (oke = 2·83 lb.), of which 145,000 okes have gone already to Constantinople.

The quality this year is below the average. The hair of dead goats cut off in the winter is neither so long nor so strong as that of live goats clipped in the spring.

The present year is said to be bad for the following reasons:—

1. The hair of the dead goats has in many cases been mixed with that of the live ones, which brings down the general average of quality. Also where goats were housed in the bad weather, their hair was stained by overcrowding.

2. The winter wet and starvation killed the weaker goats, which are the females and young, and these give the best hair. For this year and next there is left a surplus of older coarser-haired goats, which will again bring down the average of quality.

3. The wet breeding season caused much miscarrying, and the loss of the kids will give a loss of 30 per cent. in next year's clip.

4. The market is congested. The buyers told me in the end of August that there were 24,000 bales accumulated in Constantinople, since when 1,500 only have been sold. They say that the English market is holding back for a better price, and perhaps is distrusting this year's quality; that the American buyers are taking the place of the English, but that they (the buyers here) expect the price to fall before the stocks on hand are disposed of.

The general tendency of the trade is to increase. The price is one to two piastres (piastre = 2¼d. about) higher than last year. Prices here are calculated at pts. 108 to the Turkish pound, as against pts. 100 in Constantinople. The difference pays the carriage, so that no allowance need be made on Konia prices for cost of carriage to Constantinople. At the end of August prices were in Konia:—

White—Finest, 17 to 17⅓ pts. the oke; second quality, 15 to 16 pts. the oke; third (mixture), 14 pts. the oke. Add 3 pts. for Angora and 2 pts. for Akshehr.

Brown or yellow (Tshellengi)—Finest quality, 14½ to 15 pts. the oke—deduction made according to percentage of bad hair mixed.

The white mohair is best in the Kastamuni and Angora districts. In the Konia district it is found along the hills from Konia to Akshehr, and in the next vilayet at Karahissar and neighbourhood. Towards Nigdeh there are some tiftik goats, but I think they are mostly brown. Towards Seidishehr and Beyshehr, the majority of goats are black, and very little white tiftik comes from there. Within eight

hours from Konia the best villages are Mabass, Baghri Kurd, Meidan, Biledjik, Bashara Kavak, Kourshoumli, Tal Kenyi, Aahriz, Silleh, Killik Euren, Shandir, and Sismeh.

In Angora and Kastamuni the hair is longer and thicker, but not so fine as nearer Konia. An Angora goat in December, when his hair is at its heaviest, can give five pounds of hair, but in Konia only three. The weight of a bale of Angora mohair will be 70 to 75 okes, one of Konia mohair only 60. The length of Angora mohair might be put at 6 ins., as against three for Konia. As is natural with the shorter hair, Konia mohair is thinner and finer. The price rises, however, with length and weight, and is progressively higher from here to Karahissar along the Anatolian railway.

The reason of the difference in quality appears to be that while at Konia the hills are bare of trees and bushes, further on they are covered with "meshellik," an oak shrub. The goats feed freely on this (they will eat nearly everything), and thus it secures them both pasture and, what is equally important, shade in the summer. After the clip, in particular, hair grows longer and quicker in cool, shady places than on bare, hot hills.

I hear that at Karahissar some trouble is taken to feed the goats in the winter, and to prevent in-breeding. Here there is practically nothing done. Occasionally in wet weather the goats are housed, but in such a case they are enormously over-crowded, which stains and spoils their hair, and they are not fed. From time to time they are driven out to pick up what they can, which, if there is much snow, is very little. Black and brown goats stand the winter better than the white ones, which are more delicate even than sheep. Wet is their greatest enemy, especially after shearing, and in the breeding season, when it causes abortion. Here breeding is left very much to chance. There is a curious power in the white stock when crossed with the brown. Thirty years ago there were no white goats in Konia, but now there are many. The first cross with a white male produces a white kid with slight brown markings. The second cross is pure white. The females drop their young (usually one) in March.

The clip takes place at the end of April, about ten days earlier than with the sheep. Males are clipped first, to give the females more time after kidding. The kids are not clipped, as are the sheep, in the autumn of their first year. A black goat gives about 1 lb. hair (not exported), a brown $1\frac{1}{2}$ lb., a white 3 lb. in Konia, 5 lb. in Angora. A young goat gives no hair his first year, but after that for 12 or 13 years gives a good clip. From then onwards, though he may live for 20 years, his hair deteriorates every year. Females and young give the best hair. Mohair is never washed before export, whereas wool always is.

The Cape goats do not give such fine hair as those of Anatolia. There is no winter there comparatively, and the hair does not grow so well. There is a great want of Angora blood, and if the export were not forbidden a male goat would fetch £100 or more. In California there are now between 300 and 400 goats, but no thoroughbreds. There also there is a great want of Angora blood, a male goat having fetched 1,000 dollars.

Mohair pays 480 pts. a ton to Haidar Pasha, and 10 pts. for quay dues. There is no rebate given on a quantity. Buyers complain that they pay here at the same rate as at Kutahia and Karahissar, no reduction being made proportional to the distance.

DECORATIVE ART IN GERMANY.

All trades, dependent more or less upon gratifying the demands of taste and the æsthetic sense, are liable to fluctuations, following the gradual alterations in general standards of art, and the more variable whims and caprices of fashion, and one of the German industries affected in this manner is that interested in the manufacture of minor accessories of the upholsterer and house decorator and several closely connected trades. A very marked change in the general character of interior decoration has occurred during the past few years in Germany. The present school of architects, painters, decorators and designers, is aiming at artistic effects in which simplicity is the dominant note. The present demand is for symmetry and grace of outline, and broad even surfaces with effective chromatic harmonies, but discards the mass of minor accessories and the elaborate detail which have hitherto characterised the treatment of a German interior and the art of the upholsterer. This change, according to the American Consul at Chemnitz, was strongly pronounced last year in the exhibits of furniture and decorative designs at the industrial exhibitions held at Nürnberg, Yurikan, and other places, and especially at the exhibition of German industrial art in Dresden. At the latter there were exhibits of over one hundred completely furnished rooms. Nowhere were fringes, tassels, galloons, or the like visible. Woodwork was almost invariably smooth and but rarely touched by the carvers' tools. The change in public taste is so marked that it has affected several well established Saxon industries so seriously that the Government has felt compelled to carefully consider the situation and ascertain whether any measures can be taken to relieve the stagnation in the group of trades directly involved. The Minister of the Interior recently called upon the Chemnitz Chamber of Industry for a full report upon the matter, together with its recommendations. Chemnitz, like other German cities has, in addition to its Chamber of Commerce, also a Chamber of Industry—Gewerbe-kammer—directly representing in the productive industries both capital and labour. The Chamber has recently communicated its report to the Minister, and the following is

a summary of its conclusions. In regard to such upholsterer's accessories as are produced by a branch of the so-called passementerie manufacture, there is no question on the part of the trade but that the tendency of modern art is completely opposed to the further utilisation of their creations. This is strongly marked in the costlier forms of furniture, less so in the cheaper forms. The chief cause is the demand for smooth, even surfaces, in harmony with the prevailing canons of taste. In the category of less expensive furniture, the unwillingness to pay present prices for trimmings of good quality, has limited the use to some extent. Upholsterers complain that heavy fringes, tassels, and similar accessories, which formerly gave them much remunerative employment now are completely banished, or are replaced by modest, inexpensive edgings. Until recently, they were frequently called upon to undertake complicated designs of folded stuffs in the interior decorations of rooms, which involved preliminary sketches, and a high grade of artistic ability in the execution of the plans. The present style of decoration calls for simple materials, free from folds, with a limited amount of embroidery, which are found ready made in shops, and involve no special ability in arranging. Plaster decorators, and wood carvers and turners, state that their trades have all suffered seriously from the prevalent fashion for smooth surfaces on furniture, and in decorative architectural features. The Chamber has appointed a special Commission of experts to study the case, and the opinions of the members of this Commission are worthy of note. One member, an architect and professor in the technical college, declared that from the hygienic standpoint he was strongly opposed to any return to former styles, and in favour of extreme simplicity in all furnishings. Another member, the president of the Industrial Art Society, emphasised the fact that the modern decoration methods meant more light, and a free movement of air in the home than was formerly the case. Further the new movement had lifted German decorative art from a condition of stagnation, and it was now able to meet competition in the world's markets. It was to be regretted that it involved temporary loss for a group of trades, but the future development would soon offer work for the workpeople now so seriously affected. The Commission was, however, unanimously of the opinion that the tendency towards simplicity was being overdone, and was in danger of becoming a fad rather than a healthy, artistic development. Symptoms of the reaction appear to be already visible. The older patterns are now favoured in the orders given for the choicest kinds of silk stuffs employed in upholstery. There is a falling off in the demand for perfectly smooth and even articles of furniture. Projects for intervention on the part of the Government, by offering prizes for designs in harmony with the older fashions, and by influencing the courses of instruction in the schools of industrial art, were rejected as unwise and useless. It was regarded as entirely outside the province of an administration to attempt to stem or guide movements which concern exclusively questions of public taste and fashion, and to intrude into the domain of æsthetics. This recommendation will no doubt be followed by the Saxon Government. In the present state of unexampled prosperity in most of the industries of Saxony, especially in the textile branches, the classes of workmen affected by these changes will, it is said easily find occupation. At present, however, they are inclined to treat the apostles of "the simple life" with scant courtesy.

THE PROGRESS OF JAPAN.

Writing three years ago upon the commerce and industries of Japan, the president of the United Chambers of Commerce, Baron Elichi Shibuoawa, said there are four peculiarities in the Japanese character which make it hard for the people to achieve business success. "These are: Firstly, impulsiveness, which causes them to be enthusiastic during successful business, and progressive, even to rashness, when filled with enthusiasm; secondly, lack of patience, which causes easy discouragement when business is not so successful; thirdly, disinclination for union; and fourthly, they do not honour credit as they should—that which is so important a factor in financial success." However that may be, the commercial progress of Japan since the war has been very marked. As a result of the war Japan's commercial interests are largely extending southward through China, westward through Korea and Manchuria, and northward to Siberia and Saghalin. The three great ports of Yokohama, Kobe, and Baku, though not geographically in closest proximity to the countries named, in 1906 dealt with seven-eighths of Japan's exports, as they did in 1903 and in 1896. The commercial centre of gravity has not shifted, but the course of events is infusing new life and activity into the extremities of the Empire, as indicated by the rise in the value of exports from all other parts of Japan combined. The value in 1896 was about £1,500,000; in 1903 it had risen to nearly £3,500,000, and in 1906 to the considerable sum of £5,348,346..

In his report on the trade of the Consular District of Yokohama, just issued (Cd. 3283), Mr. Acting Consul-General Hobart-Hampden gives it as his opinion that the import of cotton goods will soon be insignificant. In 1906 they were of the value of £1,103,461. The Japanese mills are more and more able to cater for local requirements, and there is no doubt in Mr. Hobart-Hampden's judgment that in the near future ordinary grey goods will follow the case of T. cloths and of 7 and 8¼ lb. shirtings, and be exclusively manufactured in Japan, although a few pieces of the foreign better class 9 lb. may continue to have a certain vogue for some years. On the other hand, Japanese weaving establishments are not yet capable of turning out cambrics or general shirtings,

and it is thought that there will be an increased importation of such cloths for some time. 1906 will be remembered in consequence of the extreme prosperity of the spinning and weaving industry in Japan. Profits were enormous, and a large increase in the number of spindles is the result. In addition to this increase several new companies have been started, and the expansion is likely to continue for another year, since early deliveries of machinery could not be obtained. The mills are well sold ahead, and have contracts which will keep the spindles busy for some time to come.

Raw and waste silk was exported in 1906 to a value of £11,729,763, manufactured silks of £4,070,172, together £15,862,935, silk exports representing 77 per cent. of Yokohama's total exports for 1906, a fact which illustrates the paramount importance of this branch of Japan's export trade. The following figures, in bales, give the total exports of raw silk for the years indicated, and its distribution:—

QUANTITY IN BALES.

	1902.	1905.	1906.
To America	48,467	52,755	73,775
,, Europe	28,787	18,278	28,832
Total	77,254	71,063	102,607

With regard to the quality of the present season's silks Mr. Hobart-Hampden says that it may be classified as a medium one, and considering that owing to climatic conditions cocoons have been, generally speaking, exceedingly good, it cannot be said that reelers have taken special care to improve their goods. The Japanese Government, however, is doing its best to improve and develope the silk culture and reeling processes by creating special schools for the perfecting of rearing and reeling, and the Consul-General reports a steady improvement in both directions, "although this improvement may not as yet have made itself distinctly apparent throughout the trade generally."

The following table shows the share of the principal participating countries in the imports and exports of Yokohama:—

VALUE.

Country.	Imports.	Exports.	Total.
	£	£	£
British Empire	6,498,099	2,919,441	9,417,540
China	1,257,821	1,309,327	2,567,148
Germany ..	1,856,988	325,942	2,182,930
United States	2,801,585	10,571,514	13,373,099

Of the total trade with the British Empire, £6,151,429 went to the United Kingdom, and £1,894,941 to India. The only British possession to show an advance was Canada, for which flour partly accounts. It may be noted that Yokohama's trade with the United States exceeds that port's trade with the British Empire by £1,158,974; but this, says the Acting Consul-General, "is merely a striking instance of the danger of quoting from the figures of a particular district. In point of fact, the trade of Japan as a whole with the British Empire in 1906 exceeded her exports to the United States by no less than £11,854,330, while the imports from the United Kingdom alone fell short of the exports to the United States by little over £2,500,000." It would have added to the value of Mr. Hobart-Hampden's report if he had explained how it is that the exports to the United States from Yokohama are so large as compared with the total exports of this country to America.

Mr. Hobart-Hampden says that Japan is at present averse from widening openings for foreign imports. Aided by a high statutory tariff, once more raised from October 1, 1906, designed primarily for revenue purposes, but also designedly protective, she aims on the one hand at cutting down her bill for imports, which in the year under review were exceeded by exports, and on the other hand at becoming not only her own supplier of manufactures, but also in an increasing degree the supplier of the markets of the Far East. Her efforts in this direction are being attended with success. Comparing 1896 with 1906, her exports to China have increased from £1,470,236 to £12,023,327; to Korea from £332,078 to £2,573,500 to Siam from £1,045 to £24,027. But if there is a desire to restrict foreign privileges there is willingness to invite the co-operation of foreign capitalists in large enterprises for the exploration of the natural resources of Japan, and the development of her industries. "Japan has already become the great industrial country of the Orient. She has a good asset in a considerable supply of water-power of which she is now availing herself, while her proximity to her Eastern markets, and the support of a Government unsurpassed in the methods of encouraging external trade and organising systematic competition, place her in a favourable position. At the present period of *post bellum* restlessness, excessive speculation, and company promoting, prudence is necessary; but i there is a disposition to narrow the avenues of approach for imports there may, perhaps, in a few directions, and in individual instances, be some room for a cautious participation of British energy in the growing activities of the country. Still at best profitable occasions can only be rare, and the present attitude of welcome may prove to be only a passing phase. What is most needed by Japan is capital. She has already made use of her own capital not only in various private undertakings, but in supplying the needs of the State. The only way by which it will be possible to go on with various enterprises is to import foreign capital, but if that is to be got the barriers must be removed, such as the restriction of the ownership of land by aliens, the limitation placed by the Railway's Act upon the pledging of railway properties, and other prohibitions of foreigners as regards mining, &c. Something has been done in this direction since the war, but more remains to be done.

ARTS AND CRAFTS.

Batik Work.—In view of its great popularity on the Continent, it seems rather odd that we never see any Batik work in England. It is not that we have never heard of it; the magazines devoted to art take good care now-a-days that what is done in the remotest corner of the civilised world shall be known all over the globe—and Batik work is no exception to the general rule. And yet, the fact remain. One may go to a dozen Arts and Crafts or Home Art Exhibitions here in England, and see no example of the work, while abroad it has become sufficiently popular to find a place in schools of art, and to be imitated by enterprising German manufacturers. It was, of course, only natural that it should be taken up primarily in Holland—for Batik work, as we most of us know, had its origin in Java, which is a Dutch colony. The production of such work by European art-workers is more or less the outcome of the desire on the part of Holland to push the products of her own colonies. One would have imagined that, in a country like our own, where the search for new art crafts is so persistent, any fresh suggestion would have been eagerly welcomed. But, as regards Batik work, this has not been the case. That may be partly because cotton printing is such a highly developed industry with us that any craft which competed, however remotely with it, seemed doomed to failure. Or, again, it may be because our English would-be craftsmen and craftswomen are more impatient than their Continental brethren, and prefer to spend their time on processes which either show more results for their labour or do not take so much care in production. For all that, it would appear that they might do worse than take to Batik work. The method is the hand worker's way of doing what the manufacturer does by discharge or resist, to which last it is more naturally allied. That portion of the material which is not to be coloured is coated with wax, and the whole thing is then put into the dye pot. When it comes out, the uncovered parts of the material are found to be dyed blue, or brown, or whatever it may be, while the wax has prevented the colour from penetrating to those portions of the design which it covers. Not entirely, however, for it constantly happens that the wax cracks, or partly cracks in places, and lets the colour through in fine cobweby lines, producing sometimes an effect rather like marbling over the whole, or part of the design. This may not be altogether commendable as workmanship, but it often helps the colour effect of the work pretty considerably, and is artistically really one of its charms. The colours most commonly employed in European work are brown and blue, and a certain amount of red, but the examples which come from Java are sometimes partly executed in a rich dark green colour, which seems as if it might have been produced by the combination of blue and brownish yellow. Though Batik work is most commonly executed in cotton, it is often done on silk, and it is also carried out on parchment and on soft leather. The work done in the West Indies, where presumably time is of little or no value, is often very intricate, but that which is executed in Europe is a good deal simpler in character. There is, of course, nothing new about the process, but its results are sufficiently unlike those of ordinary printing to be at once striking and suggestive.

Embroidery and Costume.—The fashion of historical pageants, in which the dresses of the actors are decorated after the manner of a byegone age, and the present taste for embroidered dresses, wraps, coats, &c., have together been taxing the ingenuity of those who devote themselves to the less serious kinds of embroidery. The demand, of course, is met in a great measure by work produced by the sewing machine. Such embroidery is naturally mechanical and does not look altogether satisfactory when it is too closely inspected, but it is effective enough in its way; it is turned out very rapidly, and it can be executed on velvet with apparently much more ease than handwork—in the case of which the pile often gives a good deal of trouble. One's natural feelings are, of course, all against this machine embroidery, but the work so produced has undoubtedly greatly improved of late; and for the decoration of ordinary skirts and o pageant dresses which will presumably only be worn a few times and have only to be seen from a distance, it strikes one as absolutely wasteful to employ anything like fine hand work.

Another and more satisfactory kind of work which is encouraged by the prevailing fashion is that of simple designs executed entirely in couching. In the finer work gold thread, thick silk, or thin cord are used, while in the coarser a quite heavy cord, or even a fine braid, is sewn down. In this type of embroidery more depends upon the skill of the designer than upon that of the embroideress. Such simple couching is easy of execution to anyone who has a reasonable knowledge of her trade—the essential thing is that the lines of the design should be sweet and that its general distribution should be pleasing. What is wanted is not so much very great accomplishment as reasonably good taste together with a knowledge of what can be quickly executed and of what will tell in the finished work. It is occasionally desirable that this outline work should for the sake of emphasis be associated with a little solid work, perhaps with touches of *appliqué*. When, however, this latter, instead of consisting of stuff laid flat on the ground, is arranged in pleats or gathered, or ruckled up, rather after the manner of a kind of glorified ribbon work, the effect leaves a good deal to be desired, for it completely destroys what dignity there may be in the design and takes away all feeling of restfulness. When the ornamentation takes the form of natural flowers standing out in high relief and made of pieces of silk or satin only attached in places to the material of the garment, we feel that, to all intents and purposes, the embroidress has given place to the milliner.

It is, by the way, satisfactory to note that some of

the societies for the encouragement or sale of needlework are turning their attention to the production of embroidered cuffs, revers, &c., which are simple and unpretentious in design and, though effective as need be, can be executed without an undue amount of labour.

Applied Art and Economics.—Questions of industrial art have a way of verging on economics. That is only natural when we consider how closely that part of applied art, which in the long run tells most, is allied to manufacture and trade. There are, of course, a good many people who see in this close connection between art and manufacture only something to be deplored, but the combination is in the main for the good of both parties. There are times, however, when the outsider, and even the insider so far as the workman is concerned, allows it to obscure the point at issue. Just now, for instance, there is an outcry against the conditions which prevail in the homework trades carried on in the slums of London and other great cities. There is also a good deal of talk, and a good deal of experiment, going on about the establishing of art crafts in the country and under ideal conditions of employment. Undoubtedly the outcry in the one case is sadly needed, and the ideal in the other is altogether admirable. That much must be admitted with sincerity by all fair-minded persons. But there is absolutely no guarantee that work executed under perfect economic conditions will be good art, or even good workmanship. Indeed, I think we could most of us recall, with but little reflection, work so executed which left much to be desired. And on the other hand, work done in uncongenial surroundings, though not likely to rise to a very high level of art (if the executant is responsible for its design) is not necessarily bad in workmanship. To make match-boxes at, say, 2¼d. a gross in a small and, perhaps, insanitary room is not a life which can be considered in any way right or desirable. The existence of such a state of affairs would seem to the ordinary mind to prove rather that it would be better to make such things by machinery, than to support the case for the beauty and dignity of hand labour. That other workers under other conditions can produce beautiful work does not conclusively prove that these particular workers could do anything of the kind. We have, however, ample evidence that a good deal of the so-called "art-work" which is being put upon the market is neither technically nor artistically good. Let us by all means call out against bad conditions of labour; let us try all the experiments we can for improving such conditions; but in the name of logic and common-sense let us abstain from assuming that it is possible to put such things as punnets and match-boxes side by side with wood-carvings, enamels, leatherwork, &c., and talk about "the contrast between work that *ought* to be done and would be done under a wise system of government, and the work that unfortunately *has* to be done under present conditions."

CORRESPONDENCE.

THE MOTOR-CAR TRADE IN THE FAR EAST.

Mr. Gordon E. Greig, of Raub, Pahang, Federated Malay States, writes respecting the article on "The Motor-car Trade in the Far East" (August 23rd, p. 969):—

Both in Singapore and the Federated Malay States solid tyres have been tried (*not* Clincher, which are pneumatic) and found wanting. I do not think there is a single solid-tyred car in the Federated Malay States now, except a few old Albions and a motor service of Albions. Four-cylinder cars and single-cylinder De Dions and Rovers are the favourite cars.

A very large number of cars are fitted with magneto ignition; in fact, *all* the larger cars are, most with dual ignition; and, although I am not so *au fait* with the Singapore cars, dry batteries are almost universal elsewhere. All lubricating oils come from home.

The statement that air-cooled motors are not a success is unfounded. I have ridden air-cooled machines now for three years, from 2-h.p. to 5½-h.p. twin, and I have never experienced over-heating, so-called, even when towing a trailer for 35 miles on one of the real hot days, with a 3-h.p. engine.

As to the radiators upon water-cooled engines remaining hot for days at a time, the temperature never rises above 95°, and falls below 80° at night. Surely twelve hours is enough for any engine to cool down.

As to railways, there is one across Singapore. Another from Malacca town right through to Penang. Another from Port Swettenham to Khala Lumpor. Another from Port Dickson to Seremban.

Motor-cars are exceedingly useful and popular, and in Perak and Selangor are used to a very great extent by the Europeans both in the Government, and out. In the Federated Malay States, at least, the Chinese do not use their cars very much, as they have not the travelling to do that the Europeans have, and do not care, as a rule, to travel over the country, with a few exceptions.

[The statements in the article referred to were all made on the authority of the American Consul-General at Singapore. From independent inquiries made in this country it appears that solid tyres (Clincher tyres are made in both the solid and pneumatic form) are now being shipped to Singapore. The success or non-success of air-cooled motors may be regarded as a matter of opinion. A competent authority in London confirms the view expressed in the article. Of course the opinion expressed referred to motor-cars, not to motor-bicycles, from the use of which, to judge from the context, Mr. Greig's experience seems to have been derived.]

OBITUARY.

Sir Charles Arthur Turner, K.C.I.E.—Sir Charles Turner, late Member of the Council of India, and formerly Chief Justice of the Madras High Court, died at his residence in Ennismore-gardens, on the 20th inst. He was born at Exeter in 1833, and from the grammar school of his native town he went to Exeter College, Oxford, where he graduated M.A., and was elected to a Fellowship in 1855. At the age of twenty-five he was called to the Bar (Lincoln's-inn), and went the Western Circuit. In 1866 he was appointed Judge of the High Court of the North-Western Provinces of India, now the United Provinces. He acted as Chief Justice in 1870, 1875 and 1878. The writer of the obituary in *The Times* says, "A man of strong feelings and warm heart, Turner may not have had the typical judicial temperament. Yet he was eminently fitted for the preferment to the Chief Justiceship of Madras, which came in 1879. Not only had he facility for laying his finger on the vital points of a case; he was also skilful in the work of organising and supervising mofussil establishments, and in drafting, quickly and clearly, High Court orders and notifications. Moreover, his unusual physical strength was unsparingly devoted to the public service. He revelled in the subtle intricacies of Indian law and custom; and he gave every encouragement to the local Government in the habit of referring complicated questions of administration or proposed legislation to the High Court. He speedily mastered the salient points of large schemes or systems, such as the local revenue administration, which was quite different from what he had been accustomed to in Allahabad, and the abstruse customary law of Malabar and the West Coast." He was Vice-Chancellor of the Madras University in 1880 and 1882. He retired from the Bench in 1885, and became a member of the Public Service Commission. Returning to England in 1886, he was selected two years later by Lord Cross to fill the judicial seat on the India Council. He served for the statutory period of ten years, and was Vice-President of the Council in 1896-7. He was created a K.C.I.E. in 1879.

Sir Charles Turner was elected a member of the Society of Arts in 1890. He was a member of the Indian Section Committee, and presided and spoke at the meetings of this section on several occasions.

GENERAL NOTES.

Smyrna Carpets, Dyes and Colours.—In the course of his report upon the trade and commerce of the Consular district of Smyrna (Cd. 3727-4) Mr. B. A. Altintop, of the British Consulate-General, refers to the dyes and colouring substances used in the Smyrna carpet industry, and says that nearly all are imported from Germany and France. The information given to Mr. Altintop by the head of one of the most important local British manufacturers of carpets is that the German and French dyes are both better and cheaper than similar British products. The German manufacturers either visit the district personally or send their agents, who penetrate into the chief centres of the interior where carpets are manufactured, show their dyes to the men, or teach them how to employ them. The British manufacturer, or his travellIng agent, is never, according to this authority, seen in Smyrna. As for the samples and patterns contained in a book published by a dye manufacturing firm in the United Kingdom and sent to a carpet manufacturer, the same authority affirms that most of the dyes of which samples are given are German dyes imported into the United Kingdom. The same authority gives also the names of two German manufacturers who had personally visited Smyrna and the carpet industry centres in the interior, and had established solid business connections. A certain amount of nature-colouring substances, such as valonea, yellow berries, madder root, &c., have also to be used in subduing colours, &c. Indigo (natural) until a few years ago used to be imported exclusively from India, but within the last few years German synthetic indigo has been replacing the natural article.

"Tunbeki" Tobacco.—Ispahan is the great centre of "tunbeki" tobacco cultivation, a class of tobacco practically unknown in the United Kingdom. It is not adapted for use either in the form of cigarettes, or of pipe tobacco, but is consumed exclusively in the Persian kaliûn, or Turkish narghillé (water-pipe). Though in more or less general use all over Asia Minor and Egypt, the Ispahan product is for the most part consumed in the Mediterranean littoral. Smyrna, with its dependencies, is an important consumer, but Beyrouth and Syria generally come first. Tastes differ, says Mr. Consul-General Barnham, in referring to the matter in his report on the trade of Ispahan and Zezd (Cd. 3727-6), in these two districts, the former preferring the light coloured and milder leaf, which is much stronger. Egypt is also a large consumer, and there, as well as in Turkey, the importation is in the hands of a monopoly. A less important market is Greece which, however, of late years has started growing this article. The United States take a small quantity, probably for the use of the many Greeks and Syrians who emigrate to that country. Syria also produces an inferior quality, grown from seed originally imported from Ispahan. Mesopotamia and the Red Sea littoral do not consume the Ispahan plant; the former takes that grown near Shiraz, and the latter, that produced in Laristan. This latter is shipped principally from the port of Lingah. Constantinople and the Black Sea littoral consume very little of the Ispahan plant, using instead the Kashan tunbeki, which is packed after being saturated with brine.

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All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

COLONIAL SECTION COMMITTEE.

A meeting of the Committee of the Colonial Section was held on Tuesday afternoon, 30th ult. Present: Sir Westby B. Perceval, K.C.M.G. (in the chair), Byron Brenan, C M.G., Hon. Sir Charles W. Fremantle, K.C.B., Robert Kaye Gray, Arthur H. Reid, Sir William Hood Treacher, K.C.M.G., Sir Frederick Young, K.C.M.G., with Mr. S. Digby, C.I.E., Secretary of the Section.

VIVA VOCE EXAMINATIONS IN MODERN LANGUAGES.

During the present year 21 examinations have been held in London, Manchester, Bristol and Guernsey.

At these examinations 629 candidates presented themselves, of whom 476 passed (75 with distinction) and 153 failed. The languages taken up were French, German and Spanish.

The results of previous years are as follows:—

Year.	Number Examined.	Passed.	Failed.
1902	280	202	78
1903	456	324	132
1904	540	375	165
1905	681	502	179
1906	644	469	175

The following is a complete list of the *Vivâ Voce* Examinations held during 1907:—

Place of Examination.	Date.	Number of Candidates.	Passed with Distinction.	Passed.	Failed.
French:—					
Tottenham Polytechnic	March 18.	54	1	39	14
Willesden Polytechnic..	March 19.	27	1	19	7
Acton and Chiswick Polytechnic	March 20.	16	2	10	4
Guernsey Education Committee	May 16.	23	2	17	4
French (*continued*):—					
City of London College (Candidates from London Polytechnics)	June 10.	39	2	27	10
Regent-street Polytechnic (Candidates from London Polytechnics)	June 11.	36	2	26	8
Manchester Education Committee	June 20.	16	4	8	4
"Barnsbury Park" L.C.C. School	June 24 & 25	57	6	45	6
L.C.C. Evening School, Essendine - road, Maida-hill	June 25.	11	—	8	3
L.C.C. Evening School, Sussex-road, Brixton	June 26.	18	2	14	2
L.C.C. Evening School, Blackheath - road, Greenwich	June 27.	25	2	19	4
L.C.C. Evening School, Plough-road, Clapham Junction	June 28.	38	5	27	6
Merchant Venturers' Technical College, Bristol	July 9 & 10.	97	4	65	28
German:—					
Tottenham Polytechnic.	March 22.	18	2	8	8
Birkbeck College (Candidates from London Polytechnics)	June 12.	46	16	18	12
L.C.C. Evening School, Hackford-road, Brixton	June 19.	19	8	8	3
"Barnsbury Park" L.C.C. School	June 20.	22	7	9	6
Manchester Education Committee	June 21.	5	1	3	1
Merchant Venturers' Technical College, Bristol	July 15.	39	4	18	17
Spanish:—					
Manchester Education Committee	June 17.	5	2	3	—
City of London College (Candidates from London Polytechnics)	July 2.	18	2	10	6
		629	75	401	153

The following are the examiners' reports:—

French.—457 candidates were examined. Of these 33 passed with distinction, 324 passed, and 100 failed. The number of candidates examined this year was slightly in excess of the total of last year's Examination. Few failures arose through defective pronunciation. In this respect last year's standard was fully maintained. Whilst several exercises in dictation were

faultless, and a tolerably large number virtually perfect, many failures were attributable to weakness in this part of the work. In conversation, the candidates for the most part acquitted themselves very creditably, and instances of brilliancy were by no means rare. The general impression produced by the examination was distinctly favourable. One of the most gratifying features was the keen interest manifested by the students in their work. The value of an oral test in a modern language is great, and the importance of having some such proof of knowledge is gradually becoming more widely recognised.

German.—149 candidates were examined. Of these 38 passed with distinction, 64 passed, and 47 failed. The number of candidates examined was larger than in any previous year. The percentage of passes showed a slight increase; that of distinctions a slightly greater one. The feature of this year's examinations was the comparatively high number of really excellent candidates who did first rate work in all parts of the examination. There were again a number of very weak dictation papers, though only a few who did well in other parts of the examination failed in this. Probably a very few minutes rather more frequently devoted to this exercise would be found of advantage to most students. On the whole the results were highly satisfactory, and showed that a great deal of very sound language teaching is, often most unostentatiously, being carried on in this country.

Spanish.—23 candidates were examined. Of these 4 passed with distinction, 13 passed, and 6 failed. On the whole the result of the examination was very satisfactory. The majority of the candidates expressed themselves fluently and accurately on the various subjects discussed. Their pronunciation was generally good. Several exercises in dictation were nearly faultless, but in some cases it was evident that candicates had not had sufficient practice in writing from dictation. Weakness in this part of the work caused the rejection of a few candidates.

PROCEEDINGS OF THE SOCIETY.

CANTOR LECTURES.

DETERGENTS AND BLEACHING AGENTS USED IN LAUNDRY WORK.

By Prof. Herbert Jackson, F.I.C., F.C.S.

Lecture III.—Delivered April 27th, 1907.

The use of soap for cleaning purposes is such an everyday occurrence that the question how it acts and what are the reasons for its behaviour as a detergent may seem at first sight to be sufficiently answered by the facts of common experience. The problem is, however, of considerable interest and by no means easy of solution. A chemical and physical account of this well known action of soap which shall offer a full and satisfactory explanation of it can certainly not be given in the present state of our knowledge. So far as the chemical action is concerned, certain facts about the relation of soap to water are known which may be considered to have a definite bearing on its behaviour as a detergent, although interpretations of the facts may vary. If a neutral soap carefully prepared and purified so as to be free from any free alkali or uncombined fatty acid is dissolved in a little hot water to a clear solution, and a considerable amount of cold distilled water is added, there is a marked turbidity produced which is found to be due to the formation of insoluble acid soaps, that is to say, alkaline salts of the fatty acids containing more than one equivalent of fatty acid combined with the alkalies, while at the same time caustic soda goes into solution. Only a small part of the soap dissolved is affected by this change which is frequently described as the "hydrolysis" of soap. As a rough estimate, and dealing with the average strength of soap solutions used for washing purpose, the amount of alkali liberated in this way would not be more than from two to five grains of caustic soda (NaOH) per gallon, a quantity which under ordinary circumstances would speedily be converted into sodium carbonate by carbonic acid present in the water. An experiment to show this formation of traces of alkali may be made as follows. To a small volume of warm and fairly strong soap solution add a drop or two of phenol-phthalein, with which any ordinary soap will give a red colour, and then add very dilute sulphuric acid until the red colour is just discharged. If the solution is now diluted with a considerable volume of distilled water free from any acid, the red colour will be restored to some extent, showing the presence of alkali liberated by dilution.* The extent of hydrolysis varies with different soaps, with the temperature, and with the amount of water added. The accurate determination of the amount of alkali liberated presents some difficulties, and details of the analytical methods to be employed are outside the compass of this lecture, but a general idea

* A more certain way of showing this is to dissolve some soap in alcohol, to filter the solution, and to add to the filtrate a drop or two of phenol-phthalein. If a red colour is produced, add acid until it is just discharged, but if no colour is seen add weak caustic alkali until a very faint pink tinge is seen. On now diluting with water, the liberated alkali will give a full red colour with the indicator.

may be obtained from the numbers given in the following Table. They are from determinations made on specially prepared neutral soaps dissolved in the proportion of one part of soap to 400 parts of water, and show the amount of alkali set free as percentages of the total alkali originally combined in the soaps:—

Soaps.	Temperature.		
	15° Cent. (59° Fahr.)	40° Cent. (104° Fahr.)	90° Cent. (192° Fahr.)
Cocoa nut oil ..	5·8	8·1	8·5
Cotton seed oil..	6·2	7·3	10·4
Palm oil	7·4	8·5	9·6
Beef tallow	6·8	9·1	10·2
Sodium oleate ..	7·1	5·7	4·1

Too much stress must not be laid on these numbers, as it is found that varying the conditions of the experiments will yield somewhat different results, but it may be noticed that, as a general rule, soaps made from the glycerine compounds of fatty acids having a high average molecular weight are more readily hydrolysed than those from fats containing acids which have a lower molecular weight. Sodium oleate differs from the others in being more affected in the cold than at higher temperatures. It would lead too far to go into this subject fully enough to explain what has been done by various investigators on the hydrolysis of soaps, but the broad facts, in addition to those which have been already stated, are that alkali exercises a marked action in preventing the action of water, that neutral soaps dissolve in strong alcohol without apparent change, and that glycerine also somewhat lessens the extent of hydrolysis. Practically there is very little difference between potash and soda soaps in their behaviour with water in this respect.

The recognition of the fact that soaps do undergo a change when dissolved in water has led to the suggestion that their efficiency as detergents may be considered to be partly due to the action of the liberated alkali on the grease which accompanies most dirt. In dealing with alkalies it has been pointed out that the amount of saponification of grease produced by weak alkaline solutions in the conditions in which they are used is very slight, and that their effects are to be attributed rather to their powers of emulsifying fats and oils.

As the property which soap also possesses of making emulsions with grease is increased in a marked manner by the addition of small amounts of alkali, the hydrolysis of part of the soap employed may be, therefore, considered to supply the alkali required to raise the emulsifying power above that which is inherent in the soap alone. If this were all that has to be considered it might be expected that those soaps which are more readily hydrolysed than others would be the best detergents. This appears to be true in a general sense so far as strictly comparable soaps are concerned, that is to say, alkaline salts of fatty acids of the same series, *e.g.*, lauric, myristic, palmitic, and stearic acids, provided equivalent quantities are taken and the temperature of the water is warm enough to hold a reasonable amount of sparingly soluble soaps like sodium palmitate and stearate in proper solution. But it would not necessarily be true to ascribe the rather greater detergent power of soaps derived from acids of relatively high molecular weight to their increased hydrolysis alone, *i.e.*, to the greater amount of alkali liberated by the action of water on them, for these soaps by themselves have emulsifying properties superior to the soaps of lower fatty acids, and also furnish a lather more readily if used under suitable conditions.

Oleic acid, which belongs to another series of acids, furnishes soaps of considerable solubility in water, and potassium oleate is about two and a-half times as soluble as sodium oleate. If equivalent quantities of these and of soaps from other common fatty acids are taken and a number of comparative experiments are carefully made, it will be found that the detergent properties of the oleates both in cold and hot solutions are sensibly the greater. This cannot be attributed to increased hydrolysis, which is about the same as that of some of the others in the cold, and becomes less as the temperature rises; moreover, the same superiority is found using equivalent amounts of the various soaps in solution in strong alcohol. The difference must, therefore, be due to the greater inherent emulsifying and perhaps lathering power of the oleates, and to other properties which will be dealt with presently. With regard to lathering, experience shows that a good washing soap should give a full lather, but this should probably be looked upon as a sign of other useful properties rather than as a necessity in itself.

So far then the behaviour of soap as a detergent has been ascribed to its own inherent power of emulsifying grease aided by that of the alkali liberated by hydrolysis, the dirt being

either carried away clinging to or enclosed in minute oily globules, or more frequently freed from a slight binding coating of grease, and removed separately in the soapy liquor.

No account has, however, been taken of the influence which soap may exert on the state of division of the dirt, an influence which has an important bearing on the problem of washing with soap and water. To consider this it is necessary to make some preliminary remarks about the behaviour of different sized particles suspended in liquids, but without attempting to discuss theoretical questions more than in a very general way, or than is necessary to make clear the meaning of experimental facts.

If a little clay be rubbed up with water and the mixture left to settle it will often be found that a certain amount of turbidity is left in the water, and that the suspended matter will take days to sink. The turbidity can, however, be removed by passing the liquid once or twice through good filter paper. If the same experiment be tried with gamboge, it will be found that although much of the solid can be filtered off, a residual turbidity will be left which cannot be sensibly diminished by repeated filtrations. Under high magnification with the microscope, the filtered liquid is seen to contain minute solid particles which are, however, so small that they pass through the pores of the filter paper along with the water. If instead of filtering in the ordinary way a drop of gamboge fluid is allowed to fall on a piece of filter paper so that as the drop spreads filtration shall take place along the plane of the paper, the minute particles of gamboge are hindered in their movement with the water stream, and, becoming entangled among the fibres of the paper, are left behind the water which forms a colourless ring round an inner patch of yellow gamboge. The particles of gamboge were visible under the microscope, but evidence can be obtained of the existence of solid matter in a state of apparent solution in water which the microscope will not reveal, except, perhaps, in a few cases, and by using special illumination and optical appliances.

A solution of gold (Faraday's gold), which appears of a ruby colour and perfectly transparent by transmitted light, can be made by dissolving 1 grain of gold trichloride in about a quart of distilled water (the double chloride of gold and sodium sold for photographic toning may be used, but does not give such good results), and adding a few drops of a weak solution of phosphorus in ether. The colour developes slowly, and if the vessel was clean and the water pure, the solution will remain without depositing any solid for a long time—in one case for three years. A little common salt solution changes the colour to a bluish purple, and alters the state of aggregation of the gold particles, so that in a comparatively short time all the gold is deposited as a purple powder. If a little of the ruby solution be dropped on to filter paper in the same way as in the experiment with gamboge the coloured gold remains round the centre of the spreading liquid, and the water passes on. By dropping a little of the purple solution on to filter paper soon after the addition of common salt the purple gold is hindered in its movement more than any unchanged ruby, so that the two forms of coloured gold can be seen separated showing that the particles of purple gold were larger than those of a ruby colour, and accounting for the greater rapidity with which they settled out of the apparent solution. Many similar experiments on filter paper can be made with solutions sufficiently coloured to show well. Most people must have noticed the white rim round a stain of wine freshly spilt on a tablecloth. An extract of logwood in distilled water shows it very well, and so also do several other dyes and colouring matters, but the evidence must not always be taken as conclusively proving the presence of particles which can be filtered away in this manner because some colouring matters have a chemical affinity for cellulose, and form compounds with it of a more or less stable kind.

A further experiment with logwood is of interest. Drop a little of the aqueous extract on to a filter paper, and when the spreading has ceased it will be found that dropping water gently on to the stain does not increase its size perceptibly, but that if an alkali such as a weak solution of sodium carbonate be used the colour changes to purple and the stain extends considerably. This appearance is not due merely to the greater ease with which the deep purple colour resulting from the action of the alkali can be seen, but arises also from a real spreading of colouring matter taken up into more perfect solution. Moreover by letting the alkaline solution drop through the paper the stain can slowly be dissolved away. Whether the action of alkalies is to form compounds with the particles of the colouring material of a smaller size than those in which it originally existed, or whether compounds of the dye and cellulose are decom-

posed by alkalies is immaterial for the present purpose of illustrating the use of an alkali to remove a stain. Probably both actions occur. A solution of borax is more effectual in washing out the stains of logwood and many similar colouring matters, but borax undoubtedly has a special decolourising action on such stains apart from its action simply as an alkali.*

Returning for a moment to the ruby-coloured solution of gold, the presence of particles too small to be seen with the microscope may be revealed by passing a beam of light through the solution, and looking at it from a position at right angles to the direction of the beam. The track of the beam will be shown up by reflected light from the gold particles, and will look brownish and opaque, as if the light were being passed through anything but a clear liquid. Many apparent solutions which show the behaviour with filter paper, which has been described, will exhibit the track of a beam of light to a more or less marked extent, but what may be called more perfect or true solutions such, for example, as those of potassium bichromate, and most other coloured salts, or of methyl orange and many other colouring matters, will fail to show the beam of light at all if they are carefully filtered. If such solutions are dropped on to filter paper, the colour will be seen to extend right up to the margin of the expanded stain, unless there is a chemical affinity between the colouring matter and the cellulose of the paper. When the colour is seen to extend completely in this way it will generally be found that plain water is capable of washing out the stain.

It will be gathered from what has been said that the particles which, as solid dust or diffused through liquids or in solution, constitute the origin of dirt or stains that the launderer is required to remove by the process of washing, may vary in size from those almost visible to the eye, through different gradations of decreasing dimensions to particles of such minuteness as to be revealed only by the reflection of light, or to those too small even for this test of their presence.

Leaving the very minute and ultra-microscopical particles, the granules visible under magnification may be considered from the point of view of the conditions which determine or modify their state of aggregation. It is easy to realise that in the case of a fabric composed of interlacing fibres there will be limits to the sizes of groups of granules of dirt, very wide no doubt, within which they may readily be removed; the larger groups falling away as it were in virtue of their size, while the others owing to their smallness can be washed away by streams of fluid penetrating the fabric. But groups held together by grease or otherwise, and occupying intermediate positions in size, might be entangled among the fibres or cling to them to such an extent as to render it practically impossible to set them free unless their size could be diminished by separating their constituent particles more or less completely. To gain an idea of the way in which soap in its action as a detergent brings this separation about it is necessary to return to the microscopical examination of a turbid fluid. An appropriate example to take is the fluid left after washing a very dirty cloth in soap and water. If it be left for some time to allow the coarser dirt to sink it will be found to remain black and thick for an indefinite period. A drop of it placed on a glass slip and covered with a thin cover glass will show under an amplification of about 500 diameters countless minute particles in a constant state of oscillation, the larger forms moving more sluggishly and through shorter distances than the smaller forms, which are seen to dance about with great activity. If such a turbid fluid is hermetically sealed up to prevent any evaporation and no chemical changes occur, the movement will apparently persist indefinitely. Specimens of similar fluids sealed up twenty years ago show undiminished activity, and no doubt many others of much greater age are in existence, while minute particles visible in fluids sealed up in small rock cavities must have been in motion for a period to which no definite limit can be put. All turbid fluids

* This can be seen by taking a weak extract of logwood and adding equivalent amounts of dilute solutions of sodium carbonate, caustic soda, soap and borax to separate portions. Each will give a purple or violet colour, but on standing, or better on warming, the borax solution will become a pale yellowish colour, while the others will still be coloured more or less strongly, the tints varying from purple to a reddish violet, which may become browner on exposure to air. There is some evidence that borax in solution may be hydrolysed to a small extent in the same manner as soap, but the experiments with the latter and with caustic soda on logwood extract show that the action of borax to decolourise the stain is not to be attributed to the liberation of caustic alkali from the borax by the action of water, but to a specific action of borax itself. Hæmatoxylin, which is the source of the colouring matter in logwood, dissolves in water, but more readily in a solution of borax, with which it forms an indefinite compound. A similar relation between borax and the basis of colouring matters allied to that of logwood may exist, and would explain the action of borax to remove stains of such colouring matters.

which do not clear readily when left to settle show this movement in their solid particles to a greater or less extent. This oscillatory motion of minute particles is now spoken of as "pedesis," meaning a leaping or springing; it was formerly called Brownian movement, after Dr. Robert Brown, who first described it in the early part of the nineteenth century. No explanation of a character sufficiently complete to fit all the facts known about pedesis has yet been given.

It is not proposed to discuss the theoretical aspect of this movement here, as even to discuss the difficulties of framing any theory to explain all the facts which have been gleaned about it, would occupy much more time than can be given to this lecture as a whole. But the application to the explanation of the detergent action of soap is of importance and interest, and some of the facts about the conditions for hastening or retarding pedesis, with their bearing on the problem of washing, will be described as briefly as possible. It has already been mentioned that the smaller the size of the particles the more rapid and extensive are their movements. In the case of particles of equal size those having the lower specific gravities move more quickly than such as are of greater density. It was remarked in connection with the ruby solution, of gold that the addition of common salt caused an agglomeration of the gold, and this may now be described as resulting in such a decrease in the rate and extent of oscillatory motion as to enable the larger groupings of the specifically heavy metal to sink through the liquid. It is found as a general rule that solutions of acids, salts and strong alkalies decrease pedesis and favour the collection of separate particles into groups, or cause them to adhere to any larger masses which may be present, and it has been pointed out that all such solutions as have a marked influence in this direction are conductors of electricity, and that the effects of different solutions are roughly proportional to their conductivities. This generalisation may be taken as true in the main, and as applicable to the question under consideration of the best way of ensuring full play to pedesis in the operation of washing. There are, however, some particles, notably those of certain resinous substances, the movements of which are not sensibly hindered by solutions of great electrical conductivity. The following experiment made under the microscope will illustrate the manner in which pedesis comes into play as an important factor in the removal of dirt. A few fibres from a very dirty piece of linen were placed in cold distilled water under the microscope. The action of water alone loosened a small percentage of the adherent dirt particles which were seen to exhibit movements of the usual oscillatory character. The covered glass cell in which the fibres were put was specially arranged with very small side tubes, by means of which different liquids could be allowed to flow gently into the cell and bathe the fibres without much disturbing them. When soap solution was substituted for water, and the grease binding some of the groups of particles together began to mix with the solution, the individual particles in the groups of dirt adhering to the fibres were seen to start oscillating through exceedingly small distances, but these increased as more thorough removal of the grease left the particles freer to separate from one another. At this stage the soap solution was gently washed away with distilled water, and groups which still remained fairly intact were watched for an hour and their constituent particles were seen to continue their restricted oscillations. Free particles in the liquid exhibited active movement. A one per cent. solution of common salt was then made to flow gently into the cell. In a short time a large number of free particles had either joined together in groups or had settled on the fibres, and the oscillating movements of the groups were seen to have practically ceased. Water was then washed gently through the cell for some time, and finally the fibres were again irrigated with soap solution. The experiment was watched until in about three hours all the groups had practically broken up into free particles, which, either when near the fibres or in the open fluid spaces, were seen to persist in active oscillations. Similar experiments made with alkaline solutions showed that when these were used at a strength much greater than that necessary to assist soap as an emulsifying agent, and to prevent any formation of acid soaps, they exerted an influence in retarding pedesis, much less certainly than that of common salt and similar substances, but still distinctly perceptible. Apart, therefore, from the reasons given in the former lecture, the use of strong solutions of alkalies is a mistake from this point of view.

The results of a very large number of experiments leave it somewhat doubtful whether any substances promote pedesis, so as to increase the movements of perfectly clean insoluble

particles, beyond what they would exhibit in really pure water, and whether solutions, which are stated to favour pedesis, act in any other way than to neutralise or render inoperative other substances which may be present, and exerting a retarding influence, for example, the retarding action of weak common salt solution can be counteracted to a very great extent by excess of soap. For practical purposes, however, this theoretical aspect of the question need not be considered further. What is clear is that certain conditions must be observed in order to give pedesis full effect, and that the presence of saline substances acts prejudicially. The necessary conditions for the full effect desired involve the use of as little alkali as possible, of water containing no excessive amount of dissolved solids, and of a soap which shows no retarding influence on pedesis, but which on the contrary favours its continuance and activity as much as possible. To assist in ascertaining the effects of various soaps in this connection a number of pure soaps was made, and the relative electrical conductivities of equivalent solutions of them were determined. The conductivity of any true soap solution is very low indeed, but comparative experiments show that the lower it is in any one series of soaps the higher are the molecular weights of the fatty acids from which the soaps are made, and that dealing with ordinary soaps, it is lowest for the alkaline salts of oleic acid; solutions of ammonium oleate being somewhat less conducting even than equivalent solutions of potassium or sodium oleate. Comparative experiments show also that so far as pedesis is concerned the alkaline oleates are the most favourable substances to employ for exhibiting it in its greatest possible activity in a soapy fluid.

Time is an important element to be considered if full advantage is to be taken of these oscillatory movements as assistants in ridding fabrics of dirt. What can be done with soap and alkali and with a high temperature and mechanical agitation can often be equally well accomplished in the cold with less soap and alkali and with much less chance of damage to the fabric if a sufficient length of time can be spared for the operation. Attention is called to this which experience has shown to be a fact, because it often happens that very dirty silk, or woollen articles, or delicate lace would suffer from the manner in which they must necessarily be treated if they are to be washed rapidly, while no damage can occur by simply leaving them to soak for some hours in a solution of one of the alkaline oleates.

This opportunity may be taken for considering briefly the character of a soap to be used with woollen goods. It has often been stated that potash and not soda soaps should be used for wool, and that the former yield better results in every way, the wool being left in its original soft and springy condition. This may very likely be the experience of many launderers, but it is doubtful whether the results if superior are to be considered as due to any special properties of potash soap as such. Careful comparative experiments with potassium, sodium, and ammonium oleates in a practically neutral condition do not show an appreciable difference in the behaviour of the three soaps so far as the final condition of the wool is concerned. It is possible that the advantage believed to be connected with the use of soft soap for flannels, &c., may be due rather to the greater solubility of potash salts of mixed fatty acids, admitting of the use of more soap at a lower temperature, to the small amount of free alkali which used to be present as a rule in the older forms of soft soap, and to the fact that soft soaps were at one time made from oils which contained a high percentage of the glycerine compounds of oleic and analogous acids. It is certainly very doubtful whether some of the soft soaps recently examined, and found to contain much free alkali could, in any hands, yield such good results as a neutral oil or tallow soda soap of high quality. It has been suggested that the glycerine present in soft soaps has some good effect on wool, but it is difficult to see what beneficial action it can have during the washing process. It is sometimes the custom, however, to avoid rinsing out the soap completely from flannels, and it is possible that the small amount of glycerine left in as well may tend to keep the fibres pliable, but the amount is very small, and just as good results can be obtained with copious rinsing, or with neutral soaps free from glycerine. A number of experiments was carried out on the shrinkage of flannel, and the process was watched under the microscope when pieces of the fabric were being heated in water alone, in soap and water, and in various strengths of different alkalies. The details of the experiments need not be considered here as they would occupy too much time to describe, and are moreover of little practical interest compared with the general conclusions to be derived from them. The mechanism of the shrinking or felting of

woollen articles can be understood at once when wool fibres are examined by the microscope and their general structure is seen. The imbricated scales covering the outsides of the fibres project considerably and present many hook-like edges, the catching of which in one another causes the fibres to become so entangled and intertwined as to be practically inseparable. Motion of the fibres is clearly needed to bring about this entanglement, and therefore the expansion, contraction, and twisting which result from rapid alternations of temperature are to be avoided as much as possible.

It was found in a number of trials with different specimens of flannel, &c., that, after the first inevitable shrinking had been completed, exposure for some hours without agitation to the action of water at a temperature of 32° Cent. (90° Fahr.) produced no further appreciable change, but that the same treatment, combined with vibration, caused, as might be expected, a marked shrinkage in a comparatively short time. A similar result, but less extensive, was obtained by rapidly and frequently changing the temperature of the water without, however, exceeding 90° Fahr. When the fabric was kept still, very little curling or twisting of the individual fibres at this temperature was noticed under the microscope, but on heating the water to 50° Cent. (122° Fahr.) movement was distinctly noticeable and some shrinkage occurred.

The addition of alkali (·05 per cent. Na_2CO_3) produced considerably more twisting of the fibres even at the lower temperature of 90° Fahr., with the result that more marked shrinkage took place. This strength of alkali would never be used with woollen articles by any launderer of experience, but the effect is mentioned to emphasize the necessity of avoiding any free alkali other than the very small amount which results from the action of water on a neutral soap.

An average strength of soap solution at 90° Fahr. was not found to have any marked action in promoting the twisting of the fibres, although more was noticed than in the case of water alone, but the shrinkage was negligible.

Without discussing the different kinds of woollen fabrics, and various methods of weaving or treating them in relation to the question of shrinking, the general conclusion appears to be that to retard shrinkage as far as possible, the temperature of the washing fluid should not exceed 90° Fahr., only neutral soaps should be used, and all agitation which can be prevented, whether arising from injudicious mechanical treatment or from rapid alternations of temperature during the washing or in the subsequent drying, should be avoided. There is good reason to add that the precaution of thorough rinsing after washing should always be taken.

It may, however, be mentioned that sometimes a flannel which has been washed with great care for many times without any shrinkage will almost suddenly develope a tendency to shink to a very noticeable extent. It is not easy to say why this occurs, but the probability is that a gradual slight change takes place in the fibre in the course of time and with repeated washing, due to the affinity of wool for alkali which causes it to retain a trace even when the amount of alkali present in the washing fluids used was very small and precautions had been taken to ensure thorough rinsing.

In its chemical reactions wool may be described as both acid and basic, that is to say it shows an affinity for alkalies due to its own acid nature, and also an affinity for acids due to its basic character. When wool which has been thoroughly cleansed and purified is steeped in a weak solution of caustic soda it absorbs alkali from the solution, and this alkali cannot be entirely removed except by prolonged and repeated washing with water to an extent quite impracticable in the ordinary course of laundry work.

The following experiment with fresh Norfolk wool specially purified will illustrate this. Five grams of wool were steeped in 250 cubic centimetres of a ·1 per cent. solution of caustic soda for three days. The wool was then washed repeatedly for several days in distilled water. The quantity of alkali retained by the wool was determined and found to be small, amounting to not more than ·002 grams of caustic soda ($NaOH$) or ·04 per cent. of the weight of the wool. With still more prolonged washing and soaking in distilled water, less alkali still was found to be retained by the wool, but the alkali could not be entirely removed unless the washing water were made feebly acid with, for instance, a little acetic acid. Another experiment, with five grams of wool steeped in the same strength of alkali for the same time, was made, but in this case the wool was well rinsed and squeezed in four changes of distilled water. The amount of alkali retained was found to be ·014 grams of caustic soda, or ·28 per cent. of the weight of the wool. From strong solutions of caustic soda wool will absorb very considerable quanti-

ties of alkali, but very much less in the case of the milder alkalies such as sodium carbonate or borax, and less still from soap solutions. It is, of course, understood that in ordinary washing wool would never be exposed to the action of caustic alkali, as in these experiments, but they serve to show how with repeated washings small amounts of alkali can be accumulated until a change may be brought about in the fibres of a woollen fabric sufficient to give rise to shrinkage. With a view to preventing this possibility, the articles after having been thoroughly rinsed might be soaked in a weak solution of acid containing, for example, not more than 1 per cent. of glacial acetic acid. Fluid preparations stated to preserve the softness of flannel and to give it a fine finish are occasionally offered to launderers. In all the examples which have been examined free sulphuric acid has been found to be the main constituent. The use of any preparations of such a nature is to be condemned, for although wool offers a far greater resistance to acids than it does to alkalies it retains small amounts. In the case of such an acid as sulphuric acid, concentrated as the traces of it would become on drying and heating the fabric, the fibres would inevitably be affected and made rotten in time. Acetic acid is somewhat less readily retained by wool, and its action on the fibres under the conditions described would be very slight indeed.

Before proceeding to the subject which is to occupy the latter part of this lecture, viz., simple methods of identifying and separating the fibres of the ordinary materials which the launderer has to deal with, it may be useful to call attention to an easy way of removing such ingrained stains as sometimes occur on articles which have come in contact with machine grease or some similar form of very finely-divided dirt associated with fatty matter. In the preliminary stages of washing it may, and, in fact, often does, happen that such grease is spread by heat over a larger portion of the fabric, and much of the dirt is left behind in a patch, in a manner analogous to the separation of particles in the experiments on filter papers, which have been described. Had sufficient soap with a little alkali acted on the grease at first, so as to produce a good emulsion, both grease and dirt would have been washed away together; and, therefore, one method of treating the stain would be to rub in fresh grease, and then to attack it with a liberal supply of soap. It is, however, far better to rub oleic acid, which is liquid at the ordinary temperature, well into the stain, and, when it has thoroughly penetrated the fabric, to add a little weak solution of ammonia so as to form a strong solution of an ammonia soap in most intimate contact with the fibres and the dirt. On gently kneading and pressing it will be found that as the soap is forced out it carries the dirt with it, and a wash with water, with perhaps a little more dilute ammonia, will remove all perceptible traces of the stain. In this way it has been found that marks of this nature which have resisted several washings and the use of strong alkalies have been readily removed in less than five minutes.

It is not necessary for the launderer to acquire such a knowledge of the nature and reactions of all the various fibres which may be present in fabrics as would enable him to make complete qualitative and quantitative analyses of them, but it is very useful to him to be familiar with simple tests and methods for the identification and approximate separation of the common textile fibres with which he has to deal in the ordinary course of his work. These include wool, silk, linen and cotton, and less frequently ramie and jute. No attempt will be made to give more than a few reliable tests and methods, or to deal with minor distinctions between fibres such as different wools and various forms of cellulose fibres, for the purpose of determining their original sources.

The microscope affords one of the readiest and most useful means of identifying fibres. An instrument of quite a simple form only is needed, provided its optical part is of good quality. The amount of amplification required is, roughly, about 300 diameters, but it is convenient to be able to use a much lower power of about 50 diameters for a general survey of portions of a fabric. A good ⅓-inch objective (initial power 30 diameters) will bear an eyepiece giving a magnification of 10 diameters, and this combination, which allows of a fair working distance between the object and the lens, will be found convenient for the higher power, while a good 2-inch objective with the same eyepiece will afford the lower magnification. It is a great advantage to have some simple form of condensing lens fitted under the stage for focussing the source of light on the object. Higher powers and better optical appliances generally are needed for exhibiting some of the finer structure of certain fibres, but those mentioned are sufficient for the purpose of identifying fibres and studying their general structure. It would be impossible to explain

adequately the appearance of fibres under the microscope even with the help of a number of illustrations and photographs. It is better to suggest that the launderer who wishes to take advantage of the assistance which the microscope can give him should secure authentic specimens of various fibres and should familiarise himself with their appearance, and also with that of the fibres of fabrics which have been in use for some time, and have gone through the different processes of the laundry. It may be remarked in passing that a microscope is of use to the launderer for purposes other than the identification of fibres, such, for example, as the examination of starches, some kinds of glazes, and many other substances with which he has to deal, and to which foreign matters may be added as adulterants.

Methods of separating the constituents of a fabric, which can be easily applied by the launderer, are based on the following properties of the chief fibres. All forms of wool which are likely to be met with in the course of ordinary work, are completely dissolved if warmed with a solution of caustic soda containing 10 per cent. of NaOH. In such a solution, linen, cotton, and other varieties of cellulose are practically insoluble. A mixture of cotton and wool, therefore, can in this way be separated by destroying the wool and leaving the cotton. Cellulose is freely soluble in the cold in a solution of zinc chloride in strong aqueous hydrochloric acid. This solution may be prepared by dissolving one ounce of solid zinc chloride in two fluid ounces of the strongest solution of hydrochloric acid. By soaking a fabric of mixed wool and cotton fibres in this solution the wool will be left, as it is practically insoluble, although its fibres will be found to be somewhat changed.

Another method for removing cotton from wool, and one used on the large scale, is based on the greater readiness with which cellulose is disorganised by acids and the comparative stability of wool fibres under the same treatment. The mixed fabric is well soaked in a weak solution of hydrochloric acid (about one volume of strong hydrochloric acid to nine volumes of water), and then dried without rinsing. When dry the fabric is held and turned before a fire until it has acquired a dark scorched appearance on both sides. Under this treatment the cotton will have been rendered so friable and dusty that it can be beaten out of the fabric leaving the wool apparently uninjured.

Silk is somewhat less easily affected by alkalies than wool but much more readily by acids. No satisfactory separation of silk from wool can, however, be made by the use of simple alkaline solutions, as these will break up silk and dissolve too much of it if they are strong enough to dissolve wool completely.

The fibres of ordinary silk, *i.e.*, silk from the mulberry silkworm, *Bombyx mori*, as they are generally present in fabrics, are completely soluble in strong hydrochloric acid, and as neither wool nor cotton is dissolved by this reagent, silk may be separated by its use and the presence of the other fibres revealed in mixtures of wool and silk or cotton and silk. No simple or satisfactory method can be given for removing either wool or cotton from their mixtures with silk so as leave the silk intact.

The statement that silk is soluble in strong hydrochloric acid requires some modification. Raw unwashed silk consists mainly of an outer coating of silk glue called sericin, and an inner core of another nitrogenous body, containing less oxygen called fibroin. It is this latter substance which is completely soluble in hydrochloric acid. Sericin swells and gelatinises in this acid, but is not readily soluble in it. As a rule, this silk glue, which is soluble in hot water and soap solutions, or weak alkalies, is removed in the ordinary course of preparing silk for the manufacture of fabrics, but it can be rendered insoluble, and occasionally it has been found present in sufficient quantity to retard solution of the silk in hydrochloric acid, the fibroin dissolving and distorted casts of the silk fibre being left. The same result has been seen with silk which has been coated with gelatine which has been rendered insoluble in hot water or soap solutions, but in both cases the prolonged action of strong hydrochloric acid dissolves the silk, if not completely, to such an extent as to make its removal from wool or cotton quite easy with a little manipulation. There are other silks from different silkworms, of which Tussah silk may be taken as a good example, which show much greater resistance to the solvent action of hydrochloric and other acids, as well as to that of strong alkalies. There are methods known for separating such silk from wool and cotton, but their application need not be considered here, as the object is not to describe processes for the quantitative analysis of fabrics, but to give such methods of separating fibres from one another as will assist in their identification. Those which have been given, supplemented by microscopical examin-

ation and the simple tests which are now to be described, should enable the launderer to recognise the character of any of the more common fibres.

Wool and silk are rapidly dyed yellow by immersion in a solution of picric acid (about ·5 per cent). The cellulose fibres, such as linen, cotton and jute, do not take up the colour. On account of the sulphur contained in wool, a warm, dilute solution of caustic soda (about 1 per cent. NaOH), to which a few drops of a 5 per cent. solution of lead acetate have been added, will colour wool a dark brown, owing to the formation of lead sulphide. Silk and cellulose being free from sulphur do not give this reaction.

The animal fibres, wool and silk, give an intense magenta colour when treated with a solution prepared in the following way. A one per cent. aqueous solution of fuchsine (rosaniline hydrochloride or acetate) is decolourised by adding solution of caustic soda drop by drop, and is then filtered. The fabric is soaked in this solution warmed to about 100° Fahr., for a minute or two and then well rinsed with water. It is next placed in dilute acetic acid, when the colour will be developed. Cotton, linen, and other cellulose fibres remain undyed. The method of preparing the solution given is the usual one, but rather better results in some cases have been obtained by bleaching the rosaniline solution first with sulphurous acid and rendering it alkaline with caustic soda just before making the test. Such a solution is used cold or only slightly warmed.

Jute and other fibres containing lignified cellulose show a marked reaction with phloroglucinol. The test is made by immersing the fibre in a ·5 per cent. solution of phloroglucinol in strong alcohol until it is well saturated with it, and then placing it in strong hydrochloric acid, when a deep red colour will be produced. Another test for jute which is easily applied consists in soaking the fibre in chlorine water (conveniently made by adding hydrochloric or sulphuric acid to a solution of chlorinated lime), and transferring it, after rinsing, to a strong solution of sodium sulphite, when a magenta colour is developed.

No simple and satisfactory colour tests can be given for distinguishing between linen and cotton. There are several which are frequently described and which are more or less applicable to the unbleached fibres, but for linen and cotton or mixed fabrics in the condition in which they reach the launderer, no method of distinguishing them is of any practical value compared with the certain one of the microscopical examination of small portions of the fibres from both warp and weft, gently teased out in a drop of water on a glass slip and covered with a thin cover glass.

Artificial silks, such as may be met with in laundry practice, consist as a rule of fibres obtained by forcing various solutions of cellulose through capillary tubes into liquids capable of setting and coagulating the thin streams of viscid solution. The general appearance under the microscope may resemble that of silk fibres to a considerable extent, but negative reactions with picric acid or fuchsine solutions, comparative insolubility in warm 10 per cent. caustic alkali, and the absence of the marked odour of burning silk on igniting a few threads, will prove that the material is not true silk.*

The colour tests for the various fibres which have been described are clearly not suitable for dyed fabrics unless these are first bleached, nor of course could they be applied to articles in use, but minute portions can generally be obtained, without damage to the material, sufficient for making the tests or an examination by the microscope.

The knowledge of textile fibres which a launderer obtains in his general experience makes it as a rule unnecessary for him to require special tests to recognise the nature of an ordinary fabric, but when any doubt arises of the genuineness of an article and it becomes a question of the treatment which it should receive, or when an accident has happened which might be ascribable to adulteration of a fabric, it is of real value to him to be able to deter-

* The three chief varieties of artificial silks or lustra-celluloses as they are preferably called are those prepared (1) from nitrated celluloses dissolved in some solvent such as a mixture of alcohol and ether, the fibres being subsequently de-nitrated, (2) from solutions of cellulose thio-carbonate, (3) from solutions of cellulose in ammoniacal cupric oxide. The fibres of (1) swell up, become gelatinous and practically dissolve when boiled with 10 per cent. caustic soda or with concentrated hydrochloric acid. The fibres of (3) offer the greatest resistance to these reagents and retain their form even when boiled with them for some considerable time, although in the acid they are broken up into short lengths. The fibres of (2) resist the action of the alkaline solution to nearly the same extent as those of (3), but they are more readily affected by strong hydrochloric acid though not to the same extent as the fibres of (1), being only partly dissolved after long boiling in the acid. Each of the lustra-celluloses shows more tendency than ordinary cellulose to react with the bleached fuchsine solution. The fibres of (3) give the least, and of (1) the most colour which, however, never reaches a depth anything like that obtained with natural silks. None of the lustra-celluloses is dyed by a solution of picric acid even when boiled with it, and this difference between their fibres and those of natural silks forms perhaps the most useful distinction between them.

mine for himself the character and quality of the constituent fibres.

Much that is of interest in connection with these lectures has had to be left out, and much which could well have borne more extended treatment has had to be dealt with somewhat briefly, but perhaps sufficient has been said to indicate the interesting and varied nature of the problems which arise in the apparently simple process of washing.

It is hoped that towards the solution of such problems, these lectures may help to the extent of stimulating those who are engaged in laundry practice to regard their subject as one needing investigations, and their occupation as one affording the best opportunities for making them.

BUCHAREST PETROLEUM CONGRESS.

By Léon Gaster.

The third International Petroleum Congress which was held at Bucharest from the 5th to the 18th of September marks an important event in the history of the development of the petroleum industry, this being the first time that the Congress has been held in a petroliferous country, and also the first occasion on which a Government showed its interest in the movement officially by giving both financial and moral support.

The number of members of the Congress exceeded 700, of whom more than 300 were from various countries scattered all over the world. Different Governments, such as the German, Austrian, French, Italian, American, Hungarian, and Belgian sent official delegates to attend the deliberations of this international gathering, but in the case of England only the London Chamber of Commerce was officially represented.

The official opening was celebrated at the Athenæum Palace on Sunday morning at 10.30. The Minister of Domains, Commerce, Industries, &c., Mr. A. Carp, declared the Congress open, giving in his speech the history of the development of the petroleum industry in Roumania. This speech was followed by another from the Prime Minister, Mr. D. A. Stourdza, who also gave a detailed description of the petroleum industry, indicating at the same time the programme for the future activity of the Government in all the matters relating to the development of this industry.

The work of the Congress was divided into three sections, the first dealing with the geology, exploration, and exploitation of the oil fields; the second dealing with the chemistry and technology of petroleum; and the third dealing with legislation and commerce.

Out of the 300 foreign members of the Congress, over 180 representatives actually came to Roumania, the following countries being represented:—Austria with 48 members, Germany with 41, France with 25, Russia with 15, Holland with 13, Hungary with 9, England and Belgium with 7 each, and with smaller numbers from Italy, United States, Servia, Bulgaria, Sweden and Switzerland. The actual work of the Congress began on Monday morning, September 9th, at the University of Bucharest, where the members discussed the papers read before the various sections of the Congress.

The progress of the production of petroleum during the last five years has been extremely rapid. It is expected that at the end of this year the output in Roumania will exceed 1,000,000 tons. The capital invested in the petroleum industry exceeds (185,000,000 francs) £7,400,000. The contribution of the different countries is apparently made up as follows:—Germany £2,960,000, France £1,240,000, Holland £880,000, Roumania £640,000, Italy £600,000, America £500,000, Belgium £200,000, England £120,000, and several other countries about £260,000. The most important concern at present is the "Societá Anonima Romana," which has also a splendid refinery capable of dealing with 1,500 tons of oil per day. There are several other refineries erected and some are in course of erection, all conducted by well trained chemists. Mention may be madeof the refineries "Vega," "Aurora," "Astra," "Cernavoda," and that of the Roumanian American Company, near Ploesti, &c.

Of the present total production of oil, 92 per cent. is received from the exploitation of private properties, and only about 8 per cent. from the working of the State lands. Ninety per cent. of the total production is derived from the district of Prahova and about 65 per cent. of this is obtained from the fields belonging to the region of Grausor, Mislisoara, Bustenari, and Doftanetz. It is estimated that the mean production per acre in this region reaches about 10,000 tons.

For the transport of petroleum there are several methods available. The suggested pipe line to the Black Sea has not as yet been constructed, but in the district of Prahova there are about 40 pipe lines in existence with a total length exceeding 254 miles, the diameter of the pipes varying between 2 and 5 inches, but in exceptional cases 6 inches. The longest pipe line belongs to the American Roumanian Co., and runs from Moreni to the Gageni railway station. It is about 22·3 miles long, and is 3 inches in diameter. The average price charged for the transport of crude petroleum from Bustenari to Baicoiu railway station, a distance of about 11·7 miles, is £1 4s. per wagon o 10 tons, which works out to a little over ·25d. per ton-mile. There are a veiy great number of tank wagons in use for the transport of petroleum to the storage tanks at Constanza or to some ports on the Danube. The transport rate charged per ton-mile is about ·32d. In the year 1903 only 744 tank wagons were available, most of them being private property.

In the year 1906 over 1,500 tank wagons were in use of which over 1,000 belonged to private owners and only 97 belong to the State railway, but in 25 years hence the remainder of about 400 tank wagons will be passed on to the State.

The export of oil has increased enormously during the last few years, and this year it exceeded 327,000 tons, representing a value of over £1,000,000, of which about 28 per cent. are estimated to have been imported to England. Since the year 1898, when foreign capitalists first became interested in the oil industry, the exploitation of the oil fields has been exceptionally rapid. In comparing the increase of production of petroleum over the whole world between the years 1900 and 1906, one finds that in this period the production of America increased by 193 per cent., of the Dutch Indies by 317 per cent., and Galicia by 233 per cent., and that of Roumania by 355 per cent. In Russia, however, the production has decreased by 13·8 per cent.

The important rôle which the petroleum industry is destined to play in the future may be judged from the fact that the total yearly production all over the world is already estimated to exceed 28,000,000 tons. For the year 1906 the amount obtained from the different countries was as follows:—From the United States 16,000,000 tons, from Russia 8,000,000 tons, from the Dutch Indies 1,350,000 tons, from Roumania 887,000 tons, from Galicia 760,000 tons, from India 560,000 tons, from Japan 175,000 tons, from Germany 80,000 tons, and from other countries about 90,000 tons, making in all about 28,000,000 tons. The import of oil in England alone is now estimated at more than 300,000,000 gallons per annum, and when the new decision to employ liquid fuel for H.M.'s Navy comes into force, the use of oil will be very considerably increased.

The Congress proper lasted for five days from Monday to Friday afternoon, when the official closure took place at the Athenæum Palace in the presence of a large company. After the official closing of the Congress, two important excursions were undertaken, one to visit the works of the port at Constanza on the Black Sea, and the other to the oil regions in Moldavia, which latter was under the guidance of Professor S. Atanasiu. The majority of members inspected the port at Constanza. The work at the port is progressing very rapidly. The export facilities will be considerably increased when the port is completed, even up till now there have already been erected 19 storage tanks with a capacity of 5,000 cubic metres each, and it is intended to further increase their number as circumstances render it desirable. The facilities for pumping are also very great. A tank steamer of 4,000 tons could be charged in less than 24 hours, which is an enormous advance over the best that could previously be done.

The nett result of this Congress may be very great for Roumania, if in the opinion of the eminent experts geologists, who were present at the Congress, the large tracts of land belonging to the State, to private owners and to companies, could be looked upon as worthy of further systematic exploitation. The revenue derived by the State from the direct taxations provided by law, as well as that obtained from the traffic on the railway and other means of transport, may in time become a source of steady and increasing revenue to the country. For the present, the majority of the population are farmers, Roumania being mainly an agricultural country, it will naturally be of very great importance to know on what other natural resources of wealth, the Government can fall back for making reserves, in order to cover the deficits which, as a rule, follow years of bad harvest. As a national asset the petroliferous lands belonging to the State, may eventually be used to cover part of the enormous national debt.

The number of people employed in the petroleum industry at present is only a little over 8,000. It may be pointed out that great improvements have been made in the legislation dealing with the granting of concessions, such as to safeguard the interests of the investors, by making the title-deeds more secure than was formerly the case. There are, however, further improvements necessary in this direction, and I am given to understand that suitable amendments are now under the Government's consideration.

Roumania has done a great deal towards encouraging the development of home industries, inducing the population to realise the great industrial development of which the country is capable, and not to restrict themselves only to farming, which at present forms their chief occupation.

At one of the banquets given at Constanza, the Prime Minister, Mr. D. A. Stourdza, in his toast described shortly the history of the European Commission of the Danube, and full credit was given to the English engineer, Mr. (now Sir C.) Hartley for his most valuable share of work, first as chief engineer and afterwards as Consulting Engineer to the Commission.

After a sojourn of two days at Constanza, the majority of the delegates paid a visit to Constantinople, the Roumanian Government placing a special vessel at their disposal. Thus ended the programme of this most interesting and instructive international gathering.

At the closing meeting, it was decided that the next Congress shall take place at Lemberg, in Galicia, in the year 1910.

RUSSIAN PEASANTS AND THE LAND.

In his 1905 report (Annual Series, No. 3653, page 28), Mr. Consul Smith, commenting upon the condition of the peasantry in the Odessa consular district, maintained "that it was not the want of land which kept the peasantry from making both ends meet," but the antiquated "three field system" of cropping, whereby one-third of the area lies fallow. Since then several practical agriculturists have gone into the

subject, and their conclusions support the Consul's contention. One expert, with some show of reason, maintains that were the Russian peasantry to take a lesson from their German neighbours, they would be able to increase the "growing" area of their present holdings by something like 30 per cent., equivalent to an increase of 49,500,000 acres, or, in other words, that the peasantry with their present system of farming allow to lie fallow an area equal in extent to what they now demand should be allotted to them. It is further maintained that if the yield from the peasant-held land was even brought up to the present average of the large landowners, who in turn cannot show the same yield as owners in Western Europe, they could thereby produce something like 4,838,710 tons of grain for export—a return which would pay all taxes, payments for land purchase, and leave a comfortable margin over. The statistics of average yield from landowners and peasants in sixteen districts show the landowners' harvest as being 53½ per cent. more than that of the peasant, which goes to prove the foregoing assertion. This question of the cultivation of land is not one which only affects the welfare of the peasantry; the future of Russia as an exporting country is also involved. If the peasantry obtain possession of the land, and cannot produce the quantity or the quality of grain at present produced by the large landowners, the results in the export returns of the country under the head of "Food Products" must be disastrous.

Much is said about the drink bill of the United Kingdom, but the consumption of spirits in some parts of Russia is greatly in excess of anything known outside Russia. Official statistics show that Kieff stands third in the quantity of spirits consumed, but the consumption is enormous having regard to the population. The consumption of vodka in 1905 was 7,340,258 gallons of 40 degree, and as the average price at which this strength of spirit is sold by the trade is 6s. 1d. per gallon, it will be seen that the sum of £2,232,660 was spent upon this spirit alone. Taking the population of the province as being 4,200,000, the figures given by Mr. Consul Smith, there is thus 10s. 8d. per head spent on spirits. In comparing this with the quantity consumed per head in the other countries of Europe it is necessary to keep in view not only the sum spent, but also the quantity consumed per head, viz., 1·75 gallons, as well as the exceedingly low average wages earned by the working people of the province, with a peasant class representing 80 per cent. of the total. Landowners bitterly complain of the ruin caused to the peasantry by the excessive drinking in the villages. Mr. Consul Smith gives instances where the wages earned by the villagers for the work done during the year on the estates has exactly tallied with the year's turnover in the State spirit store in the village. In one instance, a large farmer paid his workpeople £750 in wages on the eve of a big holiday, and £690 of this hard-earned money was spent in vodka before the holiday treat came to an end. It is a striking fact that in the famine-stricken districts there has been an increase of £1,789,474 in the consumption of state spirits, nor is this anything uncommon in connection with Russian famines. How is it, asks the Consul, that starving peasants, without money to buy bread or corn, can obtain money to buy drink, not to mention an increase in quantity?

THE SMYRNA WINE INDUSTRY.

The climatic conditions of Western Asia Minor are exceptionally good for producing wine. When it was discovered that wine produced in that district could readily be exported to such great wine-growing countries as France, Italy and Germany, an impetus was given to the industry throughout the vilayet or province. With the advent of improved methods of culture, and a rational study of the varieties of wine which thrive best in the soil, Smyrna has been able to build up a growing and prosperous trade with foreign countries. According to the American Consul at Smyrna, the culture of the wine-grape has also spread from Smyrna to the interior of the vilayet. In contradistinction to the vineyards of Smyrna, which are principally arranged upon slopes, those in the interior have been laid out on the flat plan. The products of the vineyards of Turboli and Aiden have become celebrated for their rich flavour and splendid aroma. During the past few years, German wine-dealers have been interesting themselves in Smyrna wine, and several large vineyards are now under German management. This is having a wholesome effect for the reason that scientific methods are being introduced, and Greek vineyard owners, who have thus far practically controlled the market, are losing no time in taking the necessary steps to bring their vines up to an equal state of production. The wine produced on the mainland will soon be in a position, it is said, to compete favourably with that of Samos and other islands of the archipelago. One thing, however, which militates against a rapid development of the foreign trade is the high export duty. The wine exported from Smyrna finds its way chiefly to Hungary, where it is mixed with the native wines of that country, and then sold in European markets under the well-known name of Tokay. The grapes of Smyrna are not only made into wine, but they also produce raisins, which are extensively exported to European and American markets. The proeess of drying takes places in the open field. The ripe grapes are passed through a thin solution of alkali in order to prevent them from becoming mouldy, and also to remove certain small insects which prey upon the fruit from the time of the bud until it is picked. They are cured in the hot sun, and are finally sent in large baskets by camel transport to the nearest railway station, and thence to the port of shipment. Generally speaking, the process of pressing grapes in Asia Minor is very primitive. Apart from Smyrna, where a number of up-to-date wine presses have been introduced, the usual methop

of pressing the juice from the grape is by blocks of wood, marble, or stone, and even the feet. A large quantity of alcohol is imported into Turkey every year, chiefly from Russia and Italy, for the purpose of strengthening native wines. From the stalks and pips of the grapes a spirit is distilled which forms the favourite drink of the population. It is used either plain or flavoured with gum of the mastic tree. This spirit is mixed with water, and is said to make a pleasant and refreshing drink.

THE PIMENTO INDUSTRY IN JAMAICA.

Pimento, a dark-coloured berry, is the size of a pea with the remains of the calyx attached, and possesses the odour and flavour resembling a mixture of cinnamon, cloves and nutmegs, from which fact it derives the name of allspice. While an inferior quality grows in Mexico and parts of Central and South America, Jamaica is the country from which pimento is exported. The tree is a handsome one, attaining a height of thirty feet, with a light ashen or brown-coloured bark, which peels off in flakes as the trunk increases in size. It grows wild, and plantations or pimento walks are established by allowing a piece of land near pimento trees to become overgrown with bush, in which the birds deposit seeds from the pimento berries eaten by them, and from these seedlings grow. When the plants reach a certain size, the bush is cleared and the pimento trees are allowed to grow up. To ensure the best results, the trees should not be permitted to grow closer than twenty feet from each other. They will grow on a poor soil, provided it is friable and well-drained, as is the case on the mountain slopes of Jamaica. The tree, according to the American Consul at Kingston, yields a crop when it is seven years old, and the crops increase each year until the tree attains its full size. The berries are gathered while green, after the blossom falls. The usual method pursued is for a person to climb the tree and break off the young branches and throw them down to the women and children, who pick the berries from the stalks, separating the green berries from the ripe ones, and then carry them to the drying places. The berries are dried on trays exposed to the sun, in the same manner as coffee, the process lasting from three to twelve days. Fruit evaporators are sometimes used for drying the berry in wet weather. When sufficiently dry the seeds rattle when shaken and are of a dark colour. A third of the weight of the berries is lost in the drying. They are packed in bags or casks for shipment. In favourable seasons as much as a hundredweight of dried spice has been obtained from a single tree. Ripe pimento berries are used to make pimento dram, a native drink. Stems from the tree are fashioned into walking-sticks and umbrella handles. From the leaves of the pimento an essential oil is distilled. The exports of pimento from Jamaica in the year ended 31st March, 1906, amounted to 91,736 cwts., and in the year ended 31st March, 1907, to 85,294 cwts.

HOME INDUSTRIES.

Open-Hearth Rails.—Discussion has been quickened as to the comparative merits of the open-hearth and Bessemer rails by the rumour that a great railway company has placed an order for 2,000 tons of open-hearth steel rails for the purpose of testing them. Expert opinion is not wanting in support of the contention that the experiment, if made, will prove the superiority of the open-hearth rail over the Bessemer acid rail, and that the days of the Bessemer branch of the iron and steel trade are numbered. Should this forecast prove to be correct it is further contended that the west coast makers would suffer very seriously owing to inability to make open-hearth rails. This is, however, by no means generally admitted by authorities in the west coast steel trade. Many of them maintain not only that the Bessemer acid rail, because of its intrinsic merits, will continue to find buyers, but that the Barrow works, which are the largest rail rolling mills on the coast could, if offered the price, begin the manufacture of open-hearth rails forthwith. The thorough trial of a rail would cover years, and in that time west coast makers now without suitable plant for the open-hearth process would be able to get it, and so be in a position to execute orders.

Paper Yarn.—According to an American official report paper yarn is beginning to be largely manufactured in Germany and the United States. In the latter country it is proposed to start several mills, and in Saxony several are already at work. The yarn consists of cellulose made into flat strips of varying thickness and width. These are spun on specially constructed machines alone, or with the addition of a fine cotton thread. In Saxony the labour cost of producing one kilo (2·2 lbs.) of paper yarn is about a third of a penny, and the wholesale selling price about five pence a pound. Two German mills are turning out 20 tons of paper yarn a day. A manufacturer of carpets is said to have placed an order for 600 tons of the yarn, and one of the largest jute spinning firms on the Continent is said to have contracted for the sole right to make sacking of paper and jute yarns in combination. Amongst other things tapestries, druggets, towellings, laces, and underclothing have been made from the new yarn. It is claimed for it that it does not ignite quickly, and that it is strong and flexible.

Wolfram in Cornwall.—Reference was made in these Notes recently (*Journal*, October 4) to the presence of wolfram in Cornwall where, however, it was said "the ore deposits of wolfram, as a rule, are small and irregular." A correspondent referring to this remark, says that it is not only that the deposits in Cornwall are "small and irregular," their value is much depreciated by the admixture of tin. In Colorado the wolfram is without this mixture, and consequently is much more valuable. A recent in-

vention, the magnetic separator, is only partially successful in separating the ores. The complete separation might mean much to Cornwall, says the correspondent, for there are immense quantities of ore containing wolfram to be found in the dump heaps. It is only in recent years that the value of wolfram has been appreciated.

Bad Spinning Tests.—The latest proposal of the operatives to settle the bad-spinning dispute does not seem to commend itself to employers. It was suggested that a test be made by "ascertaining how many ends break in ten stretches on one mule, and if the average breakage reaches 1·2 per 100 spindles in ten stretches then the spinning shall be considered unsatisfactory." This, employers contend, would not give satisfaction to either side. It would be purely experimental. Who is to say, when and under what conditions the test shall be made? Bad spinning, say the employers, is sometimes caused as much by the operations of the minder as by causes over which he may have no control. It is quite probable too, as is pointed out by the *Manchester Guardian*, that a test made at one time of the day would yield altogether different results from one made at another time. Changes in the atmosphere would have a similar effect, and tests applied at different stages of the building of the cop would bring about dissimilar conclusions. The likelihood is that the proposal would have to be accompanied by so many clauses to determine the conditions under which the experiment should be made that it would end in greater dissatisfaction than now exists.

The Cotton Conference.—The following resolution has been passed at the Cotton Conference that has been sitting in Atalanta:—"That cotton be packed in a bale similar to the Egyptian bale, having a covering of osnaburgs or burlaps; the minimum weight of the bale to be 500 lbs., the maximum weight 750 lbs., and the bale to be marked at both ends, showing grade, staple, and weight; that the ginners inspect the cotton before it is baled, marking the grade on the bale; and that samples accompany the bale to obviate the necessity of opening it until it is actually delivered to the spinners." Representatives of the farmers' associations who attended the Conference declared that the farmers were willing to stamp the name and address of the producer and ginner on the bale in order that the purchaser may readily trace them in the event of complaint as to the cotton. The Conference also recommended that cotton be held for thirty days before ginning in order that much of the moisture now complained of may evaporate, and greater that uniformity as to the length of staple be secured when packing. These would seem to be excellent recommendations and decisions, which, if carried out, would go far to meet the complaints of the Lancashire spinners, but it remains to be seen whether immediate, or early, effect will be given to them. It is pointed out that only a few of the ginners may be able to afford the cost of putting in presses capable of producing the style of bale that has been recommended, and they seem reluctant to "scrap" the compressors now in use. Then, too, many of the compressors belong to the railway companies, and they may place difficulties in the way of handling cotton that has not been compressed by them. Nor are they likely to show any great alacrity in putting in new compressors.

Ground Rents in the Strand.—Some figures given by the *Statist* go some way towards explaining the delay in dealing with the stretch of ground between Wellington-street and the Law Courts. Among the few new buildings upon this area the Gaiety Restaurant and Hotel is prominent. It is now in the hands of trustees for the debenture holders, and it was recently put up for sale by their order. The building extends over an area of more than 10,000 feet, the area of its upper floors being still larger as they project to the extent of about 2,000 feet over the ground floor of the neighbouring premises. The land is held from the London County Council under an agreement for lease for a term of 50 years only from 1905, and the ground-rent payable to the Council is nearly £6,000 per annum, whilst that payable to the owner of the adjoining premises, over whose building the restaurant extends, rises to £900 per annum. This makes the ground-rent paid for the principal portion approximate to 12s. a foot, and that payable to the adjoining owner for liberty to build over his ground nearly 9s. a foot. It is said that the outlay upon the property has amounted to fully £170,000, and obviously it is an investment that would appeal to few. The highest nominal bid at the auction was £100,000, and the property was withdrawn.

Wool Production.—A very interesting and instructive report on the production of wool in Great Britain has just been issued by the Board of Agriculture. It deals with the years 1905 and 1906 and is the first of its kind. In his introductory statement Mr. R. H. Rew says that the inquiry was rendered desirable by "the renewed importance which the recovery in prices in recent years has given to the supply of British wool," and the report shows the lack that has been felt of official information on the subject. The Board has been assisted in the preparation of the report by its agricultural correspondents and market reporters as well as by many flock masters and wool buyers. In order that the possibility of error should be reduced to a minimum it was decided to defer the publication of the results of the first return until the inquiry could be repeated in 1906, and the estimates set forth represent the average returns of the two years. The following is an approximate estimate of the total annual production of wool in the United Kingdom:—Sheep shorn 87,838,000 lbs.; sheep slaughtered 30,250,000 lbs.;

ambs shorn 2,000,000; lambs slaughtered 1,000,000. Total for Great Britain, 121,085,000; total for Ireland, 12,000,000; total for United Kingdom, 133,085,000. But this total, large as it is, represents only 27 per cent. of the gross consumption. The average annual imports of wool (sheep, lambs, and alpaca) retained for home consumption in the two years 1905-6 was 360,000,000 lbs. The bulk of the imports came from within the empire. In the triennial period 1904-6, 81 per cent. came from the colonies, but in 1880-2 the percentage was even higher being, 87 per cent., the growth in the foreign import, such as it is, being almost entirely due to the development of the pastoral pursuit in South America. The report also gives much information as to the wool yield in the different counties, and of the various breeds and crosses. As a rule each breed shows to the best advantage in the district with which it is specially identified. Thus in its native county the Lincoln breed averages 10¼ lb. per fleece for ewes, and 13 lb. for other sheep, as against 9½ lb. and 10½ lb. in Derbyshire, and 10 lb. and 12½ lb. in Nottinghamshire, although in the North Riding of Yorkshire the corresponding averages were 11 lb. and 14 lb. The South Devon seems to be the most prolific wool-bearing variety, the Lincoln and Dartmoor being equal second, while the Devon long-wool comes next. The Oxford Down is first among the short-wooled breeds, the Shropshire second, and the Hampshire third. The report deals, too, with wool production from the buyers' point of view, and sheep farmers will find it worth attention.

Bank Amalgamation. — The Manchester and Liverpool District Banking Company, Limited, and the Lancashire Banking Company, Limited, have entered into a provisional agreement for the amalgamation of the two banks by the transfer of the business and assets of the Lancaster Bank to the Manchester concern. The terms provide that five shares in the Lancaster Bank will be exchanged for three shares in the District Bank, plus the sum of 21s. in cash for each share in the Lancaster Bank. Thus the paid-up capital of the Lancaster Bank of £302,500 will be replaced by £396,000 of paid-up capital in the District Bank, and the cash payment of £57,750. The reserve fund of £300,000 of the Lancaster Bank will be reduced by this additional paid-up capital, and the above mentioned cash payment to £146,250, whilst the paid-up capital of the District Bank will be raised to £1,896,000, and the reserve fund to £1,816,250. Of late the tendency has been for local or county banks to be swallowed up by great metropolitan institutions, and the change will be welcomed by many. The District Banking Company, Limited, will now have no fewer than 175 branches and sub-branches in Lancashire, Cheshire, Staffordshire, Shropshire, Yorkshire, and Derbyshire, and its total resources, amounting to £25,122,000, will give it a leading position among the great banks of the country.

CORRESPONDENCE.

HEATING OF COTTON CAKE, AND ITS PREVENTION.

The attention of the directors of The Cotton Seed Co., Ltd., has been drawn to a reprint in the *Journal of the Society of Arts* (issue of the 11th inst.) of an article extracted from the *Indian Trade Journal*, on the "Heating of Cotton Cake, and its Prevention."

In that article, the writer states that cotton cake—that is, undecorticated cotton cake—made from Indian seed is liable to heat under certain conditions, that consequently, as large stocks of the article cannot be kept, the use of Indian seed for cake is restricted.

It is desirable, however, he says, to prevent heating, and as heating is due to fermentation or bacterial action in the husk (which is commonly called in the trade, the hull) the remedy is to decorticate the seed.

He proceeds to say that no plant for the decortication of Indian cotton seed exists in the United Kingdom, and then propounds a "general idea" of a process for decortication in the hope that persons interested in seed-crushing appliances may be induced to test its practicability.

It is no doubt true that undecorticated cotton cake is liable to heat, but my directors understand that the heating is due, not to bacterial fermentation, as suggested by the writer of the article, but to that liability to combustion which is characteristic of cotton fibre when saturated with oil. Indian cotton seed is covered with a closely adherent matted fibre which cannot be separated in the ordinary process of cake-making, and is left on the hull, forming with the hull and kernel component part of the cake. The liability to heating is not the only disadvantage attendant on the storage and use of such feeding material, and for many years attention was given to the discovery of a method of separating the fibre from the hull, and hull from the kernel, with successful results, some five or six years ago. This method has been for some time in full commercial operation by this company, which holds the patent rights in the process. The decorticated cake made in this company's mill is at least equal to the best decorticated American cake, as will be evident from the fact that it commands an even better price in the market than American cake.

Its keeping qualities have been proved by the application of severe tests, bags of the cake having been sent out by us from London to Bombay, stored in India, and returned to London in perfect condition at the worst season of the year.

The writer of the article does not seem to have made himself acquainted with recent developments in this matter, and we hope you will do us the courtesy of giving as much prominence to this rectification of facts as you did to the article. When we mention that this company is now concerned with proposals for the establishment of mills in India worked by plant similar to that which is being successfully

operated here, my directors are sure that you will recognise that they have a right to expect a prompt contradiction of the statement of facts given by the insufficiently informed writer of the article in the Indian official paper.

My directors desire, in conclusion, to express their surprise that that paper should not have been better informed, seeing that the facts regarding the patent processes of this company were supplied to the India Office some three or four years ago, in connection with a discussion on this same subject, and that we possess Indian patents as well as patents for the United Kingdom.

S. C. ROBERTSON, Secretary.

The Cotton Seed Co., Ltd.,
Oil and Cake Mills,
Cubitt Town Wharf, Poplar, London, E.C.
21st October, 1907.

OBITUARY.

THOMAS FORSTER BROWN, M.INST.C.E., F.G.S.—Mr. Forster Brown, of Springfoot, Stoke Bishop, Bristol, died on the 23rd October at Richmond, Yorkshire, in the 73rd year of his age. For forty years he was deputy gaveller (mineral agent) for the Crown in the Forest of Dean, and as a civil and mining engineer took a prominent part in the development of South Wales. He was one of the joint engineers in the construction of the Barry Dock and Railways, and also of the Vale of Glamorgan Railway. Besides being a member of many societies, he was a past President of the South Wales Institute of Engineers. He was elected a member of the Society of Arts in 1896, and in April, 1899, he read an important paper on the subject upon which he was a recognised authority, entitled "Our Coal Supplies."

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 4...Farmers' Club, Whitehall Rooms, Whitehall-place, S.W., 4 p.m. Prof. Penberthy, "Some Diseases of Farm Animals."

Royal Institution, Albemarle-street, W., 5 p.m. General Monthly Meeting.

Engineers, in the Theatre of the United Service Institution, Whitehall, S.W., 7½ p.m. Mr. Horatio C. Huggins, "Bridle Roads in the West Indies."

Chemical Industry (London Section), Burlington-house, W., 8 p.m. 1. Messrs. Cyril Bergtheil and R. V. Briggs, "The Determination of Indigotin in Indigo yielding Plants." 2. Messrs. R. Gaunt, F. Thomas and W. P. Bloxam, "Analysis of Indigo (Part III.) and of the Dried Leaves of *Indigofera Arcuata* and *Indigofera Sumatrana.*"

London Institution, Finsbury-circus, E.C., 5 p.m. Prof. W. M. Flinders Petrie, "Ancient Egyptian Houses."

TUESDAY, Nov. 5...Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Inaugural address by the President, Sir William Matthews. 2. Reception by the President.

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. Thomas K. Grant, "Practical Demonstration of Autochrome Plates."

WEDNESDAY, Nov. 6...United Service Institution, Whitehall, S.W., 3 p.m. Mr. A. R. Colquhoun, "The Strategical and Economical Effect of the Opening of the Panama Canal."

THURSDAY, Nov. 7...Linnean, Burlington-house. W., 8 p.m. 1. The Rev. George Henslow, "The Origin of the Di-trimerous whorls among Flowers of Dicotyledons." 2. Mr. Albert D. Michael, "Unrecorded Acari from New Zealand." 3. Mr. R. Shelford "*Ænigmatistes africanus*, a new genus and species of Diptera."

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. H. B. Baker and Miss M. Baker, "Gaseous Nitrogen Trioxide." 2. Messrs. H. B. Baker and A. H. Bennett, "The Atomic Weight of Tellurium." 3. Mr. H. M. Godby, "The Isomerism of the Double Sulphites of Sodium and Potassium." 4. Messrs. M. O. Forster and T. Jackson, "Studies in the Camphane Series. Part xxiv. Camphoryldithiocarbamic Acid and Camphorylthiocarbimide." Mr. R. T. Lattey, "The Vapour Pressures of Triethylamine, of Sym-trimethylpyridine, and their Mixtures with Water." 6. Mr. R. T. Lattey, "Liquid Triethylamine." 7. Mr. F. S. Sinnatt, "The Action of Sulphuretted Hydrogen on Solutions of Sodium Hydrosulphite." 8. Messrs. W. J. Pope and C. S. Gibson, "The Alkyl Compounds of Gold. Diethylauric Bromide. Preliminary Note." 9. Messrs. F. B. Power and F. Tutin, "Note on the Constitution of Homoeriodictyol." 10. Mr. F. Tutin, "The Interaction of Methylene Chloride and the Sodium Derivatives of Ethyl Malonate." 11. Messrs. P. C. Ray and P. Neogi, "Preparation of Aliphatic Nitro-Compounds by the Interaction of the Alkyl Iodides and Mercurous Nitrite." 12. Messrs. J. E. Marsh and R. de J. F. Struthers, "Some Mercury Derivatives of Camphor." 13. Mr. G. G. Henderson, "Contribution to the Chemistry of the Terpenes. II. The Oxidation of Limonene with Chromylchloride." 14. Messrs. A. Senier and A. Compton, "The Synthesis of Acridines and Phenonapthacridines; Tetra- and Hexa-methylacridines; Dimethylphenonapthacridines; Dixylylmethylenediamines."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Orton Bradley, "American Composers."

United Service Institute, Whitehall, S.W., 3 p.m. Colonel C. Delmé-Radcliffe, "The Swiss Military System."

*** CORRECTION.—In Professor Gregory's third lecture on Gold Mining (*ante* p. 1041, col. 1, *note*), *for* "not more than ·002 inch" *read* "not more than ·0002 inch."

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FRIDAY, NOVEMBER 8, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

ARRANGEMENTS FOR THE SESSION.

The Opening Meeting of the One-hundred-and-Fifty-Fourth Session will be held on Wednesday Evening, the 20th of November, when an Address will be delivered by Sir STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Vice-President and Chairman of the Council. The Chair will be taken at 8 o'clock. The subject of the Address will be "Lord Clive, and his work in the foundation of the Indian Empire."

Previous to Christmas there will be five Ordinary Meetings, one meeting of the Indian Section, and one of the Applied Art Section.

The following arrangements have been made:—

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock:—

NOVEMBER 27.—"The Franco-British Exhibition, 1908." By THE HON SIR JOHN A. COCKBURN, K.C.M.G.

DECEMBER 4.—"Old Age Pensions." By SIR EDWARD W. BRABROOK, C.B.

DECEMBER 11.—"Radio-active Phenomena." (Aldred Lecture.) By SIR WILLIAM RAMSAY, K.C.B., F.R.S. SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council, will preside.

DECEMBER 18.—"The Rôle of France in West Africa." By MONSIEUR LUCIEN HUBERT, Député des Ardennes.

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock:—

DECEMBER 12.—"Big Game in India." By REGINALD GILBERT, F.Z.S., late of Bombay.

APPLIED ART SECTION.

Tuesday evening, at 8 o'clock:—

DECEMBER 17.—"How to Make the Most of a Museum." By LEWIS FOREMAN DAY, F.S.A. SIR ASTON WEBB, R.A., F.R.I.B.A., will preside.

SHAW LECTURES ON INDUSTRIAL HYGIENE.

Friday evenings, at 8 o'clock:—

NOVEMBER 29.—The Hygiene of Work in Compressed Air (Diving, Caisson Work, Sub-aqueous Tunnelling, &c.). By JOHN SCOTT HALDANE, M.A., M.D., M.R.C.P. (Edin.), F.R.S. HERBERT LOUIS SAMUEL, M.P., Under-Secretary of State for the Home Department, will preside.

DECEMBER 13.—"Industrial Poisons—Lead and Phosphorus, with special reference to Lucifer Match Making." By PROFESSOR THOMAS OLIVER, M.D.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

CONRAD BECK, F.R.M.S., "The Theory of the Microscope." Four Lectures.

November 25, December 2, 9, 16.

Meetings after Christmas:—

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (dates not fixed):—

"Screen-Plate Processes of Colour Photography." By C. E. KENNETH MEES, D.Sc., F.C.S.

"The Problem of Road Construction, with a View to Present and Future Requirements." By H. S. HELE-SHAW, LL.D., F.R.S., and DOUGLAS MACKENZIE.

"Recent Improvements in Decorators' Materials." By A. S. JENNINGS.

"The Underground Water Supplies of the Thames Basin." By CLAYTON BEADLE.

"Industrial Entomology: the Economic Importance of a Study of Insect Life." By F. MARTIN DUNCAN.

"Modern Dairy Practice." By LOUDON M. DOUGLAS.

"War Balloons." By AUGUSTE E. GAUDRON.

"The Making of Sound Waves, and their subsequent Reproduction of Sound as Exemplified by the Gramophone." By MARK BARR.

"Siam and its People." By HARRY HILLMAN.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock :—

January 16, February 13, March 12, April 30, May 21.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock :—

January 28, February 25, March 24, April 7.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock :—

January 21, February 18, March 31, April 28, May 26.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

HENRY HARDINGE CUNYNGHAME, C.B., "The Theory and Practice of Clock Making." Six Lectures.

January 20, 27, February 3, 10, 17, 24.

PROFESSOR VIVIAN B. LEWIS, "Fuel and its Future." Four Lectures.

March 9, 16, 23, 30.

WILLIAM BURTON, F.C.S., "The Nature and Structure of the Porcelains." Three Lectures.

May 4, 11, 18.

SHAW LECTURES ON INDUSTRIAL HYGIENE.

Dates not fixed :—

"The Removal of Dust and Fumes in Factories." By JOHN SCOTT HALDANE, M.A., M.D., M.R.C.P. (Edin.), F.R.S.

"The Dangers of Coal Dust and their Prevention." By W. E. GARFORTH, President of the Colliery Proprietors' Association of Great Britain.

"The Hygiene of the Pottery Trade." By WILLIAM BURTON, F.C.S., Chairman of the Joint Committee of Pottery Manufacturers of Great Britain.

"Child Workers and Wage Earners." By MISS NETTIE ADLER, Hon. Secretary to the Committee on Wage Earning Children.

HOWARD LECTURES.

Thursday evenings, at 8 o'clock :—

H. S. HELE-SHAW, LL.D., F.R.S., "The Navigation of the Air." Three Lectures.

March 19, 26, April 2.

JUVENILE LECTURES.

Two Lectures suitable for a Juvenile audience will be delivered on Wednesday afternoons, January 1 and 8, 1908, at 5 o'clock.

INDIAN SECTION COMMITTEE.

A meeting of the Committee of the Indian Section was held on Wednesday afternoon, 6th November. Present: Sir Steuart Colvin Bayley, K.C.S.I., C.I.E., Chairman of the Council, in the chair, Sir M. M. Bhownaggree, K.C.I.E., Sir George Birdwood, K.C.I.E., C.S.I., Major-General Sir Owen Tudor Burne, G.C.I.E., K.C.S.I., Henry Luttman-Johnson, John David Rees, C.I.E., M.P., Sir James Thomson, K.C.S.I., Thomas D. Thornton, C.S.I., Lieut.-Colonel Sir Curzon Wyllie, K.C.I.E., C.V.O., with S. Digby, C.I.E. (Secretary of the Section).

PROCEEDINGS OF THE SOCIETY.

INTERNATIONAL EXHIBITIONS.

The following is a first attempt to provide a list, as complete as possible, of Exhibitions held since the first Great International Exhibition of 1851, down to the present date. It is hoped that its publication may attract corrections and additions, so that at some future time it may be possible to reprint it in a revised and amended form. It has been formed from various sources, and one result of this is that the titles show a sad lack of uniformity. In many cases it has been possible to give the proper official title, or a sufficient abridgment of it. In others the available information only suffices to provide an indication of the nature and character of the Exhibition.

The list is intended to include, besides the genuine International Exhibitions, all industrial or technical Exhibitions of an important character. It is to be feared that many of the entries might well be omitted, and it may be taken as certain that the omissions are numerous. Exhibitions of works of art are not included, though even here the rule is not absolute, for it has been thought well to include such an entry as that of the Manchester Art Treasures Exhibition of 1857.

Any suggestions for amendment will be gratefully received.—H.T.W.

1851. LONDON — Great International Exhibition.
1852. CORK—National Exhibition.
1853. BRUSSELS—Industrial Art Exhibition.
,, DUBLIN—Irish Industrial Exhibition.
,, NEW BRUNSWICK—Native Industry Exhibition.
,, NEW YORK—Industrial Exhibition.
1854. CHRISTIANIA—Exhibition of Norwegian Art and Manufactures.
,, FLORENCE—Exhibition of Natural and Industrial Products of Tuscany.
,, LONDON — Educational Exhibition in St. Martin's Hall.
,, MADRID—Industrial Arts Exhibition.
,, MELBOURNE — International Exhibition.
,, MUNICH — Allgemeine deutsche industrie Ausstellung.
1855. MADRAS—Exhibition of Arts, Manufactures, and Raw Materials of the Presidency.
PARIS—Exposition Universelle.
1856. BRUSSELS—Belgian Arts Exhibition.
EDINBURGH—First Exhibition of the Art Manufacture Association.
1857. BERN—Exhibition of Swiss Arts and Manufactures.
EDINBURGH—Second Exhibition of the Art Manufacture Association.
,, LAUSANNE—Industrial Exhibition.
,, MANCHESTER—Art Treasures Exhibition.
[illegible]. NEW YORK—American Industry Exhibition.
[illegible] TURIN — Esposizione Nazionale de Prodotti d'Industrie.
[illegible]9. ATHENS—National Exhibition.
,, HANOVER—Industrial Exhibition.
,, ROUEN — Exhibition of Products of Twelve Northern Departments.
[illegible]60. ST. PETERSBURG — Exhibition of Russian Products.
[illegible]861. FLORENCE—Esposizione Italiana.
,, HAARLEM — Dutch Industries Exhibition.
,, MELBOURNE—Victorian Exhibition.
1861-2. EDINBURGH—Exhibition of Industrial and Decorative Art.
1862. LONDON—International Exhibition.
,, ROME—National Exhibition.
1863. CONSTANTINOPLE — Exhibition of Turkish Produce and Foreign Machinery.
1864. AMSTERDAM—Exhibition of Dutch Produce, Art and Industry.
,, BAYONNE — Exhibition of Industries Connected with Corn and Wine.
,, CALCUTTA—Agricultural Exhibition.
,, LONDON — North London Working Classes' Industrial Exhibition, at the Agricultural Hall.
,, LUCKNOW—Agricultural Exhibition.
,, MALTA—Exhibition of Local Art and Industry.
,, MERSEBURG—Industrial Exhibition.
,, TURIN—Esposizione dei Cotoni Italiani.
1865. BIRMINGHAM—Metals and Trades Exhibition.
,, BORDEAUX — Industrial and Artistic Exhibition.
,, BOULOGNE—International Fishery Exhibition.
,, CHAUMONT—Exhibition of the Products of the North-Eastern Departments of France.
,, COLOGNE—Exhibition of Agriculture and Horticulture.
,, DUBLIN—International Exhibition of Arts and Manufactures.
,, DUNEDIN—New Zealand Exhibition.
,, FREETOWN (SIERRA LEONE)—Industrial Exhibition.
,, LONDON — Operative Coachmakers' Industrial Exhibition.
,, ———West London Working Classes' Industrial Exhibition, at Covent Garden.
,, ———North-East London Exhibition of Arts and Manufactures, at the Agricultural Hall.
,, ———South London Working Classes' Industrial Exhibition, at Lambeth.
,, OPORTO—Exhibition of Arts, Manufactures, and Agriculture.
,, PARIS—Exposition des Beaux Arts appliqués à l'Industrie.
,, PHILADELPHIA—Exhibition of American Produce.
,, STETTIN—Exhibition of Industry.
,, VIENNA—First Working Men's Industrial Exhibition.
1866. AARHUUS—Agricultural Exhibition.
,, COPENHAGEN—Danish Industrial Exhibition.
,, LONDON—Metropolitan and Provincial Working Classes' Exhibition, at the Agricultural Hall.
,, RIO DE JANEIRO—Exhibition of Raw Produce.
,, SAIGON—Cochin China Exhibition.

1866. STOCKHOLM — Scandinavian Industries Exhibition.
,, VIENNA—Agricultural Exhibition.
1866-7. MELBOURNE—Intercolonial Exhibition of Australasia.
1867. AGRA—North-West Provinces Exhibition.
,, HAGUE—Fishery Exhibition.
,, PARIS—Exposition Universelle.
1868. BUCHAREST—National Exhibition.
,, DARWEN—Art Treasures Exhibition.
,, HAVRE—Exposition Maritime Internationale.
,, LEEDS—National Exhibition of Works of Art.
,, LONDON—Aeronautical Exhibition, at the Crystal Palace.
,, SANTIAGO—Exhibition of Products of Chile.
1869. AMSTERDAM — Exposition Internationale d'Economie Domestique.
,, BEAUVAIS—Exhibition of Agriculture and Industry.
,, CHARTRES—Exhibition of Industry and Art.
,, LONDON — South London Industrial Classes' Exhibition.
,, NAPLES—Maritime Exhibition.
,, WOLVERHAMPTON — South Staffordshire Industrial and Fine Art Exhibition.
1869-70. MANCHESTER — Missionary Exhibition.
1870. GUJERAT—Indian Cotton Exhibition.
,, LIÉGE — International Exhibition of Industrial Art.
,, ST. PETERSBURG—Russian Industrial Exhibition.
,, SYDNEY—Intercolonial Exhibition.
,, TURIN—Exhibition of Italian Products.
1870-1. CORDOVA—Esposicion Nacional Argentina.
1871.—GEORGETOWN—Exhibition of Natural Products of British Guiana.
,, JERSEY—Channel Islands Industrial Exhibition.
,, LIMA — International Exhibition of Peru.
,, LONDON — 1st Annual International Exhibition at South Kensington.
,, MILAN — Exhibition of Selected Branches of Industry.
,, NAPLES—International Maritime Exhibition.
,, TURIN — Industrial Exhibition of Natural Products.
1872. ATHENS—National Industrial Exhibition.
,, BERMUDA—Industrial and Loan Exhibition.
,, BOGOTA—Exhibition of Products of South America.
,, COPENHAGEN—Scandinavian Art and Industry Exhibition.
,, DUBLIN—Arts, Industries, and Manufactures Exhibition.
,, KIOTO—Japanese Exhibition.
,, LONDON — 2nd Annual International Exhibition at South Kensington.
,, LYONS—Exhibition of Agriculture, Industrial Products, and Works of Art.
,, MELBOURNE—Exhibition of Natural Products and Works of Art.
,, MOSCOW—Polytechnic Exhibition.
1873. CHICAGO—Interstate Exposition.
,, LONDON — 3rd Annual International Exhibition at South Kensington.
,, MADRID—Exhibition of Natural Products and Manufactures.
,, VIENNA—Universal Exhibition.
1874. BRUSSELS—Industrial Art Exhibition.
,, CINCINNATI—Industrial Exhibition.
,, LONDON — 4th Annual International Exhibition at South Kensington.
,, MARSEILLES—Exhibition of Modern Inventions.
,, ROME—Exhibition of Italian Produce and Manufactures.
1875. GENEVA—International Exhibition.
KIOTO—Exhibition of Japanese Manufactures.
,, MELBOURNE—Intercolonial Exhibition.
,, PARIS — Exhibition of Agricultural Machines and Implements.
,, ——Exposition Maritime et Fluviale.
,, SANTIAGO—International Exhibition of Chile.
1875-6. ALGIERS—Universal Exhibition.
,, MONTEVIDEO—National Exhibition.
1876. BRUSSELS—Exposition Internationale d'Hygiène et de Sauvetage.
,, HELSINGFORS—Finland Universal Exhibition.
,, LONDON—Loan Collection of Scientific Apparatus.
,, MUNICH—Austro-German Exhibition of Art and Industry.
,, PARIS—Exhibition of Applications of Electricity.
PHILADELPHIA — International Exhibition.

1876. TURIN — Espositione di Macchine Agrarie.
1877. AMSTERDAM—Exhibition of Fine Arts Applied to Industry.
,, CAPE TOWN—South African International Exhibition.
,, GHENT—Exhibition of Industrial Art.
,, HAMBURG—International Dairy Exhibition.
1878. BALLARAT—International Exhibition.
,, PARIS—Exposition Universelle.
1879. MILAN—International Exhibition.
,, PARIS—Exhibition of Applied Science in the Palais de l'Industrie.
1879-80. GEELONG—Industrial and Juvenile Exhibition.
,, SYDNEY—International Exhibition.
1880. BERLIN — Internationale Fischerei-Ausstellung.
,, BRISBANE—Exhibition of the Queensland National Association.
,, BRUSSELS—Exposition Nationale.
,, CINCINNATI—Milling Exhibition.
,, LONDON—Lighting Exhibition at the Alexandra Palace.
,, PARIS—Exhibition of Metal Industries.
1880-1. GLASGOW—Naval and Marine Engineering Exhibition.
,, MELBOURNE — International Exhibition.
1881. ADELAIDE—International Exhibition.
,, ATLANTA—International Cotton Exhibition.
,, LONDON—International Medical and Sanitary Exhibition.
,, ———International Exhibition of Smoke-Preventing Appliances.
,, MILAN — Esposizione Industriale Italiana.
,, MOSCOW—Industrial Art Exhibition.
,, NEWCASTLE-ON-TYNE — Stephenson Centenary Exhibition.
,, PARIS — Exposition Internationale d'Électricité.
1881-2. LAHORE—Punjab Exhibition of Arts and Manufactures.
1882. BIELLA—Esposizione Generale.
,, BORDEAUX—Exhibition of Industrial and Agricultural Products.
,, BRUSSELS—International Exhibition of Gas Heating Appliances.
,, CHRISTCHURCH - International Exhibition.
,, EDINBURGH — International Fisheries Exhibition.
,, GHENT—Exposition des Arts Industriels.
1882 LILLE—Exposition Internationale d'Art Industriel.
,, LONDON — Smoke Abatement Exhibition.
,, MOSCOW—Exhibition of Russian Industry and Art.
,, MUNICH—Internationale Elektricitäts-Ausstellung.
,, WORCESTER — Worcestershire Exhibition.
1882-3. BERLIN—Allgemeine Deutsche Hygiene Ausstellung.
1883 AMSTERDAM—International and Colonial Exhibition.
BOSTON, U.S.A.—Foreign Exhibition.
CARACAS — Esposicion Nacional de Venezuela.
CAEN—Industrial Exhibition.
CORK—Industrial Exhibition.
DENVER—National Mining and Industrial Exhibition.
LONDON — Engineering and Metal Trades Exhibition.
———International Fisheries Exhibition.
LOUISVILLE—Southern Exposition.
MADRID—Exhibition of Mining and Metallurgy.
PRAGUE—Industrial and Electrical Exhibition.
VIENNA — Internationale Electrische Ausstellung.
ZURICH — Schweizerishche Landes-ausstellung.
1883-4. CALCUTTA—International Exhibition.
MARSEILLES—International Maritime Exhibition.
NICE—International Exhibition.
1884. BRUSSELS—Industrial Art Exhibition.
EDINBURGH — International Forestry Exhibition.
LONDON—International Health Exhibition.
MELBOURNE — Inter-Colonial Exhibition.
PHILADELPHIA — International Electrical Exhibition.
ROUEN—Exposition Régionale.
TURIN—Esposizione Generale Italiana.
1884-5. NEW ORLEANS — World's Industrial and Cotton Centennial Exhibition.
1885 ANTWERP—Exposition Universelle.
BUDAPEST—Hungarian National Exhibition.
KÖNIGSBERG—International Industrial and Polytechnic Exhibition.

1885. LONDON—International Inventions Exhibition.
,, MONTENEGRO—Universal Exhibition.
,, MONTEVIDEO—National Exhibition.
,, NUREMBERG — Exposition Internationale.
1886. EDINBURGH—International Exhibition of Industry, Science, and Art.
,, LIVERPOOL — International Shipping Exhibition.
,, LONDON—Colonial and Indian Exhibition.
,, NEWCASTLE-ON-TYNE—Mining, Engineering, and Industrial Exhibition.
1887. ADELAIDE—Jubilee International Exhibition.
,, EKATERINBURG — Siberian Exhibition.
,, HAVRE—International Maritime Exhibition.
,, LIVERPOOL—Royal Jubilee Exhibition.
,, LONDON — American Exhibition at Earl's Court.
,, MANCHESTER—Royal Jubilee Exhibition.
,, NEWCASTLE-ON-TYNE—Royal Mining, Engineering, and Industrial Exhibition.
,, PARMA — Esposizione Industriale e Scientifica.
1888. BARCELONA—Exposicion Universal.
,, BERLIN—National Exhibition.
,, BOLOGNA—International Exhibition.
,, BRUSSELS — Grand Concours International des Sciences et de l'Industrie.
,, CINCINNATI—Centennial Exposition of Ohio and Central States.
,, COPENHAGEN — Nordiske Industri-Landbrugs og Kunstudstilling.
,, GLASGOW—International Exhibition.
,, LISBON — Esposiçao Nacional das Industrias Fabris.
,, LONDON — 1st Arts and Crafts Exhibition.
,, ————Irish Exhibition at Olympia.
,, ————Italian Exhibition at Earl's Court.
,, MELBOURNE—Centennial International Exhibition.
,, OSTEND—International Exhibition of Hygiene and Life Saving.
1889. LONDON—Spanish Exhibition at Earl's Court.
,, PARIS—Exposition Universelle Internationale.
1890. BOSTON, U.S.A.—International Maritime Exhibition.
,, EDINBURGH—International Exhibition of Electrical Engineering.
,, FRANKFORT — International Electro-Technical Exhibition.
,, LONDON —French Exhibition at Earl's Court.
,, ————International Exhibition of Mining and Metallurgy at the Crystal Palace.
,, ————Royal Military Exhibition at Chelsea.
,, VIENNA—National Exhibition of Agriculture and Sylviculture.
1891. DETROIT—International Fair and Exposition.
,, KINGSTON (JAMAICA) — International Exhibition.
,, LONDON—German Exhibition at Earl's Court.
,, ————Royal Naval Exhibition at Chelsea.
,, ST. ÉTIENNE—Art and Industrial Exhibition.
1891-2. PALERMO—Esposizione Nazionale.
,, TASMANIA—International Exhibition.
1892. AMSTERDAM — International Book Trades Exhibition.
,, KIMBERLEY—International Exhibition.
,, LIVERPOOL—Naval Exhibition.
,, LONDON—Electrical Exhibition at the Crystal Palace.
,, ————International Horticulture Exhibition at Earl's Court.
,, MADRID—Exposicion Historico Americana.
,, MOSCOW—Electrical Exhibition.
1893. CHICAGO—World's Columbian Exposition.
,, LONDON—Photographic Exhibition at the Crystal Palace.
,, ST. PETERSBURG—Exposition Hygiénique Générale Russe.
1894. ANTWERP—Exposition Universelle.
,, BUCHAREST—Roumanian Co-operative Societies.
,, LEEDS—Arts and Crafts Exhibition.
,, LIVERPOOL—Health Exhibition of the Sanitary Institute.
,, LONDON — Exhibition of Pottery at the Imperial Institute.
,, ————Optical and Photographic Exhibition at the Royal Aquarium.
,, LUXEMBURG—Exposition du Travail.
,, LYONS—International Exhibition.

1894. MANCHESTER—British and Colonial Industrial Exhibition.
,, MILAN—International Exhibition.
,, ODESSA—National Exhibition.
,, PARIS—International Book and Paper Exhibition.
,, SAN FRANCISCO—California Midwinter International Exposition.
,, SANTIAGO (Chile)—Mining and Metallurgical Exhibition.
,, VIENNA — International Food Exhibition.
1894-5. HOBART — Tasmanian International Exhibition.
1895. AMSTERDAM — Wereld - Tentoonstelling.
,, ATLANTA—Cotton States and International Exhibition.
,, BORDEAUX—Exposition de la Société Philomathique.
,, DUBLIN—Arts and Crafts Exhibition.
,, KIOTO—National Japanese Exhibition.
,, LONDON—Exhibition at the 6th International Geographical Congress.
,, ———Exhibition of Photography at the Imperial Institute.
,, ———Empire of India Exhibition at Earl's Court.
,, ———South African Exhibition at the Crystal Palace.
,, LUBECK—Commercial and Industrial Exhibition.
,, MANCHESTER—Arts and Crafts Exhibition.
,, RIO DE JANEIRO—National Exhibition.
,, STRASSBURG—Industrial Exhibition.
1895-6. ROME — International Exhibition of Fine Arts and Electricity.
1896. BARCELONA—Exhibition of Fine Arts and Artistic Industries.
,, BERLIN—Industrial Exhibition.
,, BUDAPEST — Exposition Millénaire Hongroise.
,, CARDIFF—Fine Art, Industrial, and Maritime Exhibition.
,, GENEVA—Exposition Nationale Suisse.
,, LONDON—East London Trades Exhibition at the People's Palace.
,, ———Horse and Horseless Carriage and Roads Locomotion Exhibition at the Crystal Palace.
,, ———India and Ceylon Exhibition at Earl's Court.
,, ———International Exhibition of Motors and their Appliances.
,, NIJNI NOVGOROD—Pan-Russian Exhibition.
1896. NUREMBURG—National Industrial Exhibition.
,, PRAGUE—International Exhibition of Pharmacy.
,, WARSAW—Hygienic Exhibition.
1897. ARCACHON—International Exhibition.
,, BRISBANE — Queensland International Exhibition.
,, BRUSSELS—International Exhibition.
,, GUATEMALA—National Exhibition.
,, LONDON—Imperial Victorian Exhibition at the Crystal Palace.
,, ———Victorian Era Exhibition at Earl's Court.
,, ———Yachting and Fisheries Exhibition at the Imperial Institute.
,, MADRID — Exhibition of Spanish Industries.
,, NASHVILLE — Tennessee Centennial Exhibition.
,, RENNES—Industrial, Commercial and Art Exhibition.
,, STOCKHOLM—Art and Industrial Exhibition.
1897-8. LONDON — East London Diamond Jubilee Exhibition at the People's Palace.
,, ———Exhibition of Acetylene Generators at the Imperial Institute.
1898. DIJON — Universal and International Exhibition.
,, LONDON—International Exhibition of the Royal Photographic Society at the Crystal Palace.
,, ———Universal Exhibition at Earl's Court.
,, MUNICH—International Exhibition of Motor Machinery.
,, OMAHA—International Exhibition.
,, TURIN — Esposizione Nazionale Italiana.
1899. BUDAPEST—International Exhibition of Acetylene Apparatus.
,, COOLGARDIE — Western Australian International Mining and Industrial Exhibition.
,, COMO — International Exhibition of Electrical Appliances.
,, GHENT—Provincial Exhibition of East Flanders.
,, LONDON—Greater Britain Exhibition at Earl's Court.
,, PHILADELPHIA — Commercial Exhibition.
,, RUSTCHUK—Industrial Exhibition.
,, VENICE—International Exhibition.

1900. LONDON—Women's International Exhibition at Earl's Court.

———Tramways and Light Railways Exhibition at the Agricultural Hall.

PARIS—Exposition Universelle Internationale.

——— Exposition Internationale de l'Acétylène.

1901. BIRMINGHAM—Industrial Polytechnic Exhibition.

BUFFALO—Pan-American Exposition.

CALCUTTA — Indian Industrial and Agricultural Exhibition.

CHRISTIANIA — Kulturhistoriske Udstilling.

GLASGOW—International Exhibition.

LONDON—Military Exhibition at Earl's Court.

———Naval and Military Exhibition at the Crystal Palace.

RIGA—Jubiläums-Ausstellung.

1902. AHMEDABAD Indian Industrial and Agricultural Exhibition.

AMSTERDAM International Exhibition of Photography and Allied Industries.

CORK—International Exhibition.

DÜSSELDORF—Exhibition of Industries of Rhenish Westphalia.

LONDON—American Exhibition at the Crystal Palace.

TURIN—Esposizione Internazionale.

WOLVERHAMPTON—International Exhibition.

1903. CORK—International Exhibition (2nd year).

DELHI—Coronation Durbar Exhibition.

LIMA—International Exhibition of the Industrial Appliances of Alcohol.

LONDON—Engineering and Hardware Exhibition at the Crystal Palace.

———Food and Grocery Exhibition at the Crystal Palace.

———International Fire Exhibition at Earl's Court.

MADRAS—Indian Industrial and Agricultural Exhibition.

1904. BOMBAY—Indian Industrial and Agricultural Exhibition.

BRADFORD—Cartwright Memorial Exhibition.

LEEDS—Arts and Crafts Exhibition.

LONDON—Italian Exhibition at Earl's Court.

OSAKA — National Industrial Exhibition.

1904. ST. LOUIS—Louisiana Purchase Exposition.

1904-5. CAPE TOWN—Industrial Exhibition.

1905. BENARES—Indian Industrial and Agricultural Exhibition.

,, LIÉGE—Universal and International Exhibition.

,, LONDON — Naval, Shipping, and Fisheries Exhibition at Earl's Court.

,, ———International Motor Exhibition at Olympia.

,, ———Indian and Colonial Exhibition, at the Crystal Palace.

,, PORTLAND (Oregon)—Lewis and Clark Centennial Exhibition.

1906. CALCUTTA — Indian Industrial and Agricultural Exhibition.

,, LONDON—Austrian Exhibition at Earl's Court.

,, ———Pianoforte and Music Trades Exhibition at the Crystal Palace.

,, ———Food, Health, and Hygiene Exhibition at the Crystal Palace.

,, LYONS—Electrical Devices Exhibition.

,, MARSEILLES—Exposition Coloniale.

,, MILAN—International Exhibition.

,, NUREMBURG—Industrial Exhibition.

,, REICHENBERG—Bohemian Industrial Exhibition.

1906-7. CHRISTCHURCH—New Zealand International Exhibition.

1907. BORDEAUX—International Maritime Exhibition.

,, DUBLIN—International Exhibition.

,, JAMESTOWN, U.S.A. — Tercentenary Exhibition.

,, LONDON—Balkan States Exhibition at Earl's Court.

,, TOKYO—Industrial Exhibition.

PATENTS AND DESIGNS.—THE NEW ACT.

By J. A. LAW, C.P.A.

The Royal Assent has recently been given to an Act embodying alterations in the law relating to patents and designs of great importance to inventors, manufacturers, and others. The Act contains nearly a hundred sections and all that can be done in this article, therefore, is to deal somewhat shortly with the more important innovations.

Except where otherwise expressly provided, the Act is to come into operation on January 1st next, and to extend to all patents granted and designs registered before then, and also to applications then pending.

The Act is divided into three parts, namely:—I. Patents; II. Designs; and III. General. These parts will be treated *seriatim*.

PART I.—PATENTS.

Compulsory Working.—If a patented article or process be manufactured, or carried on exclusively, or mainly outside the United Kingdom, then, unless the patentee prove that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or give satisfactory reasons why it is not so manufactured or carried on, the Comptroller may make an order revoking the patent forthwith, or he may make an order revoking it after a specified interval if the patented article or process be not in the meantime adequately manufactured or carried on within the United Kingdom; but in the latter case, if the patentee give satisfactory reasons for the failure so to manufacture or carry on within the prescribed time, the Comptroller may extend the period by not more than one year. To obtain such an order, application must be made to the Comptroller at least four years from the date of the patent, and one year from the passing of the Act; moreover, any decision of the Comptroller is to be subject to an appeal to the High Court, and no order is to be made that will be at variance with any treaty, convention, arrangement, or engagement with any foreign country or British Possession.

This provision, which, according to Mr. Lloyd-George, is the pith of the Act, introduces a very important alteration into the law relating to patents. It is true that under the previous law it was possible that a patent might be revoked on a somewhat similar ground, namely, that the reasonable requirements of the public with respect to the patented invention had not been satisfied; but this was only as an alternative to the grant of a compulsory license, and no patent has, at any rate in modern times, been revoked on such a ground. Whether the policy of revoking patents for lack of working in this country is sound or not, is at any rate very debatable, and the writer has previously advocated the placing in the hands of the Comptroller, in lieu of the power to revoke, the power to grant to suitable applicants licenses to work patents that have not been worked in this country for a given time after their grant.

Compulsory Licenses or Revocation on Petition to Board of Trade.—Petitions to the Board of Trade for the grant of compulsory licenses, or, in the alternative, the revocation of patents, on the ground that the reasonable requirements of the public with respect to the patented inventions have not been satisfied, are to be referred by the Board of Trade to the High Court of Justice instead of to the Judicial Committee of the Privy Council; the alteration is, of course, made with a view to cheapening the procedure, which, under the old law, has been practically prohibitive. It is also enacted that the reasonable requirements of the public shall not be deemed to have been satisfied if, by reason of the default of the patentee to manufacture to an adequate extent, and supply on reasonable terms the patented article or any parts thereof necessary for its efficient working, or to carry on the patented process to an adequate extent, or to grant licenses on reasonable terms, any existing trade or industry, or the establishment of any new trade or industry, in the United Kingdom, be unfairly prejudiced, or the demand for the patented article, or the article produced by the patented process be not reasonably met; or if any trade or industry in the United Kingdom be unfairly prejudiced by the conditions attached by the patentee, before or after the passing of the Act, to the purchase, hire, or use of the patented article, or to the using or working of the patented process.

Sales, Leases, and Licenses.—In any contract made after the passing of the Act in relation to the sale or lease of, or license to use or work, any article or process protected by a patent, any condition will be null and void that will either (*a*) prohibit or restrict the purchaser, lessee, or licensee from using any article or class of articles, whether patented or not, or any patented process, supplied or owned by any person other than the seller, lessor, or licensor, or his nominee; or (*b*) require the purchaser, lessee, or licensee to acquire from the seller, lessor, or licensor, or his nominees any article or class of articles not protected by the patent. The provision, however, is not to apply if the seller, lessor, or licensor, prove that at the time when the contract was entered into the purchaser, lessee, or licensee had the option of purchasing the article or obtaining a lease or license on reasonable terms, and without such objectionable conditions; and if, also, the contract entitle the purchaser, lessee, or licensee to relieve himself of his liability to observe the objectionable conditions on giving the other party three months' notice in writing, and on payment of such compensation as may be fixed by an arbitrator appointed by the Board of Trade.

Any contract made before the passing of the Act, and containing conditions that would be null and void under this provision had the contract been made after the passing of the Act, may be determined by either party on giving three months' notice in writing to the other party, subject to the payment of such compensation as, failing agreement, may be awarded by a Board of Trade arbitrator.

An action for infringement can be defended on the ground that, after the passing of the Act, the patentee inserted into a contract relating to the patent and still in force a condition of the kind above defined.

It should be noted that it is not unlawful to insert a condition whereby a person is prohibited from selling any goods other than those of a particular person, or whereby the lessor or licensor reserves to himself or his nominees the right to supply such new parts of the patented article as may be required to put or keep it in repair.

Any contract relating to the lease of or license to

use or work any patented article or patented process, whether made before or after the passing of the Act, may, when the article or process is no longer protected by a patent, be determined by either party on giving three months' notice in writing to the other party; but in the case of any contract made before the passing of the Act, such determination is subject to the payment of compensation.

It is no secret that the section in question was chiefly aimed at the methods of the American Trusts, one of which, according to Mr. Lloyd-George, has practically compelled the boot industry in this country to employ their machines exclusively, and has obtained contracts with the manufacturers such that if an improvement on the invention to which the contracts relate, were taken up at the end of nineteen years, the trade would be bound to take the improvement, and renew their leases for another twenty years, and so forth, apparently *ad infinitum*. It was consequently necessary in the opinion of the Government to protect this very powerful industry, and to say that this country really could not stand the use of a privilege conferred by the Crown for the purpose of hampering a whole trade.

Opposition to Grant.—In addition to the present ground of opposition, the grant of a patent is to be opposable on the ground that the invention has been claimed in a complete specification that will be dated prior, but not more than fifty years prior, to the patent the grant of which is opposed, or on the ground that the nature of invention, or the manner in which it is to be performed, is not sufficiently or fairly ascertained in the complete specification. The former of these two new grounds is to enable the grant of a patent to be opposed on the basis of an application made in this country, and founded, under the International Convention, on a prior application made abroad.

Revocation and Defence of Infringement Actions.—Any person who would have been entitled to oppose the grant of a patent, or the successor in interest of such a person, may, within two years from the date of the patent, apply to the Comptroller for its revocation on any ground on which the grant of the patent might have been opposed; but the leave of the Court is requisite when an action for infringement or proceedings for revocation are pending in the Court. The decision of the Comptroller is to be subject to appeal to the Court.

Any ground on which a patent may be revoked by the Comptroller, or, as an alternative to the grant of a compulsory license on the ground that the reasonable requirements of the public with respect to the patented invention have not been satisfied, is to be available as a defence to an action for infringement, or as a ground for revocation by petition to the Court.

In an action for infringement a defendant entitled to present a petition to the Court for the revocation of the patent may alternatively counter-claim for revocation.

Remedies for Non-payment of Fees.—If a sealing fee have not been paid within the prescribed time, whether or no that time have expired before the end of 1907, the Comptroller may, subject to the prescribed payment, extend the time for the payment of the sealing fee.

If a patent have become void through the non-payment of a fee within the prescribed time, unless the omission were intentional and undue delay occurred in making the application, the Comptroller may, after giving an opportunity for opposition to the application, issue an order restoring the patent; but persons who may have availed themselves of the patented subject-matter after an official announcement of the voidance of the patent are to be protected.

Disconformity.—If any examiner report that an invention described in a complete specification is not substantially the same as that described in the provisional specification, the Comptroller may, with the consent of the applicant, cancel the provisional specification, and treat the application as having been made on the day on which the complete specification was left; but where the complete specification is in disconformity only by reason of the insertion of additional matter, the claim for the additional matter may be treated as an application for that invention made at the filing of the complete specification, and the original application may be allowed to proceed so far as concerns the invention covered by both specifications.

A patent is no longer to be held invalid on the ground that the complete specification claims an invention additional to or different from that contained in the provisional specification, provided that the additional or different invention were novel at the filing of the complete specification, and that the applicant were its first and true inventor.

Concurrent Applications.—If the same applicant have obtained concurrent provisional protection on separate applications for inventions which are cognate, or modifications one of another, the Comptroller may, if of opinion that they can be properly covered by a single patent, accept a single complete specification in respect of the whole of such applications. The single patent granted is to bear the date of the earliest application; but in considering the validity of the patent, and for the purposes of opposition, regard is to be had to the respective dates of the several provisional specifications.

Before availing himself of this provision, an applicant should carefully consider whether, for the sake of the saving in fees, it would be worth while to run the increased risk of invalidation, which, of course, is often proportional to the number of inventions covered by a patent.

Patents of Addition.—A person having applied for or obtained a patent, may, in respect of any improvement or modification of the invention, apply for what is called a patent of addition, which will have the advantage that no renewal fees will be payable thereon, but the disadvantage that it will remain in force only as long as the patent for the original invention.

Nothing is said as to what would happen should no patent be granted for the original invention, and it should be noted that in most cases a patent of addition would probably give to the patentee no further protection than would be accorded by the original patent.

Chemical Inventions.—In the case of a chemical invention, the Comptroller may require typical samples and specimens to be furnished before accepting the complete specification.

This provision has been inserted with the object of preventing patents from being obtained for ideas that are merely nebulous, and thus to prevent persons from being hampered who have first conceived means for bringing such ideas to practical success.

Prolongation of Patents.—Hitherto, to obtain the prolongation of a patent, it has been necessary to present a petition to the King, and the petition has been referred to the Judicial Committee of the Privy Council, with the result that the obtaining of an extension of the term of a patent has been a very costly matter. After December 31st next, a patentee may, at least six months before the time at which the patent would ordinarily expire, present a petition for its extension to the Supreme Court. It is, therefore, to be hoped that the cost of securing such extensions will be materially reduced.

Anticipation.—Prior publication of an invention or any part thereof, if the matter published were derived or obtained from the patentee and published without his knowledge and consent, is no longer to be a ground for the voidance of a patent, provided that the patentee, after learning of the publication, applied for and obtained protection for his invention with all reasonable diligence.

Innocent Infringers.—No damages can be recovered for infringement of a patent granted after December 31st next from any person proving that at the date of the infringement he was unaware, and had no reasonable means of making himself aware, of the existence of the patent. The application to a patented article of a word indicating that a patent has been obtained is not to be deemed to constitute notice of the existence of the patent, unless the year and number of the patent be added.

Official Search.—After a date to be fixed by the Board of Trade, every official search as to the novelty of the subject-matter of an application for a patent is to extend to specifications pertaining to prior publications but published after the date of the application under investigation, and if it appear that the invention is wholly or in part claimed in any specification so published, the applicant, whether or not his specification have been accepted or a patent granted to him, is to be afforded facilities for amending his specification, and failing his doing so the Comptroller will determine what references, if any, ought to be made in the specification by way of notice to the public. An application is be regarded as prior to another if a patent granted on the former would be of prior date to a patent granted on the latter; this will enable the specifications of applications filed here subsequently to an application under investigation, but based under the International Convention on prior applications made abroad, to be included in the investigation.

Refusal of Anticipated Applications.—In lieu of requiring references to be made in an applicant's specification as a result of an official search, the Comptroller may, after the 31st of December next, refuse to grant a patent; but he can do so only if satisfied that the invention claimed has, in some specification to which the official investigation has extended, been wholly and specifically claimed.

Inventions of Deceased Persons.—The limit of six months, within which an application for a patent for an invention for a person deceased must be made by his representative, is to be removed.

Fraud.—A patent granted to an inventor in lieu of a patent revoked on the ground of fraud, is to bear, instead of the date of revocation, the date of the revoked patent, but no action is to be brought for any infringement of the patent so granted committed before the date of the actual grant of the substitutional patent. The alteration in the dating of the substitutional patent is important from the point of view of priority.

Joint Grantees.—Under the present law the grant of a patent to joint applicants gives a joint interest which passes to the survivor or survivors, unless there has been a severance of that interest, and each patentee can retain any profits he may make by working the invention himself, though it is questionable whether if he grant licenses, he will not be accountable to his co-patentees for the royalties obtained. Under the new law, unless otherwise specified in the patent, joint grantees are to be treated for the purpose of the devolution of the legal interest as joint tenants, but, subject to any contract to the contrary, each, whilst being entitled to use the invention for his own profit without accounting to the others, is not to be entitled to grant a license without their consent, and on his death his beneficial interest is to devolve on his personal representative as part of his personal estate.

Instruments or Munitions of War.—The provisions hitherto in force in regard to the acquisition of inventions and patents for improvements in instruments and munitions of war, and keeping secret corresponding specifications by the Secretary of State for War, are to apply also to the Admiralty, and it is enacted that, for the purpose of insuring secrecy with respect to such patents, rules may be made modifying previous provisions of the law.

PART II.—DESIGNS.

Abandoned and Refused Applications.—An application is to be deemed abandoned if, owing to the default or neglect of the applicant, registration have not been effected within the prescribed time. If an application have been abandoned or refused, the application and any drawings, photographs, tracings, re-

presentations, or specimens left in connexion therewith are not at any time to be open to public inspection or to be published by the Comptroller.

Period of Copyright.—On application within the prescribed time before the expiration of the original five years of copyright and on payment of the prescribed fee, the Comptroller is to extend the period of copyright by a further five years, and on application within the prescribed time before the expiration of the second period of five years, the Comptroller may, on payment of the prescribed fee, extend the period by another five years.

Prior Publication.—The confidential disclosure of a design by the proprietor, and the disclosure of a design in breach of good faith by any other person, and the acceptance of a first and confidential order for goods bearing a new or original textile design intended for registration, are not to be deemed to be publication of the design sufficient to invalidate its copyright if registration be obtained subsequently to the dislosure or acceptance.

Marking.—According to the law now in force, failure to apply the prescribed indication of registration will cause the copyright to cease unless the proprietor shew that he took all proper steps to insure such marking. Under the new law, failure to act in this manner is not to entail the loss of the copyright, but in the event of any such failure the proprietor is not to be entitled to recover any penalty or damages for infringement, unless he shew that he took all proper steps to insure the marking of the articles, or that the infringement took place after the person guilty knew or had received notice of the existence of the copyright.

Where representation is made to the Board of Trade by or on behalf of any trade or industry that in its interests it is expedient to dispense with or modify, as regards any class or description of articles, any of the requirements as to marking, the Board may dispense with or modify such requirements.

Designs used Wholly or Mainly Abroad.—The provisions of the Act respecting the revocation of patents for inventions worked exclusively or mainly outside the United Kingdom, are, with the necessary modifications, to apply to the cancellation of the registration of designs, except that an application for cancellation may be made to the Comptroller at any time after the registration of a design, and that there is to be no appeal from the decision of the Comptroller.

An action for infringement of the copyright of a design may be defended on the ground that the design is used for manufacture exclusively or mainly outside the United Kingdom.

Anticipation by Prior Registration.—The application of the proprietor of a design already registered in respect of one or more classes is not to be refused, and its registration is not to be invalidated, on the ground that the design was so previously registered, or on the ground that the design had been previously published in the United Kingdom by reason of its application to goods in respect of which it was previously registered.

Inspection of Designs.—A shorter period than the existence of the copyright of a design, but not less than two years from the registration of the design, may be prescribed for the general prohibition of the inspection of a design and taking of copies thereof, and different periods may be prescribed for different classes of goods.

PART III.—GENERAL.

Branch Offices.—Provision is made for the establishment of branch offices for designs at Manchester or elsewhere, and for the leaving of any document, or the doing of anything, at any branch office that may be established, instead of at the Patent Office.

Registers.—It is directed that entries shall be made in the registers in regard to mortgages, licenses, and other interests in patents and designs. Modification is also made in the provisions as to the rectification of registers.

Errors in Patents.—The Comptroller is empowered, on applicetion and on the payment of the prescribed fee, to correct clerical errors in patents.

Excluded Days.—The previsions of the law now in force with regard to Bank Holidays and other days on which the Patent Office is closed, are extended by an enactment to the effect that if the last day fixed by the Act for doing anything fall on any day specified in rules under the Act as an excluded day, the rules may provide for the doing of the thing on the next following day that is not an excluded day.

False Marking of Designs.—If any person, after the expiration of the copyright in a design, put on any article to which the design has been applied any words implying the subsistence of the copyright, he will be liable on summary conviction to a fine not exceeding five pounds.

Royal Arms.—The grant of a patent under the Act will not authorize the patentee to use the Royal Arms in any way.

Appeals and Petitions to the Court.—Every appeal from a decision of the Comptroller to the Court, and every petition referred to or presented to the Court, is to be made, referred, or presented to a Judge of the High Court selected for the purpose by the Lord Chancellor, and the decision of that Judge is to be final, except in the case of an appeal from a decision of the Comptroller revoking a patent on any ground on which the grant of the patent might have been opposed.

Evidence before Comptroller. — In proceedings before the Comptroller, evidence is, in the absence of directions to the contrary, as before, to be given by statutory declaration; but, if he think it right to do so, the Comptroller, who is empowered to administer oaths for the purpose, may take evidence *vivâ voce*, and may allow any person to be cross-examined on his declaration.

Costs before Comptroller and Law Officer.—In proceedings before the Comptroller relating to an opposi-

tion to the grant of a patent or to the amendment of a specification, or relating to the revocation of a patent, the Comptroller is to have power to award reasonable costs and to direct how and by whom they are to be paid.

If a party giving notice of opposition to the grant of a patent, or applying to the Comptroller for the revocation of a patent, or giving notice of an appeal from any decision of the Comptroller, neither reside nor carry on business in the United Kingdom or the Isle of Man, the Comptroller or the Law Officer respectively may require the party to give security for costs.

Title "Patent Office."—Any person using the title "Patent Office," or any other words suggesting that his place of business is officially connected with, or is, the Patent Office, is to be liable on a summary conviction to a fine not exceeding twenty pounds.

Agents.—Provision is made for authorizing the Comptroller to refuse to recognize as agent any person whose name has been erased from the Register of Patent Agents, or who would have rendered himself liable to have had his name so erased had his name been on the register; or any company which, had it been an individual, the Comptroller could refuse so to recognize; or any company or firm having as director, manager, or partner, any person whom the Comptroller could refuse to recognize as agent.

The Comptroller is to refuse to recognize as agent any person neither residing nor having a place of business in the United Kingdom or the Isle of Man.

Repeal.—In this article it has been endeavoured to indicate, of course, merely the important alterations of the law resulting from the Act, but the Act will ultimately take the place of the whole of the Acts relating to patents and designs (except the Statute of Monopolies) now in force; and the only portions of those Acts which will not automatically cease to be in force on January 1st next, are those relating to the procedure for the revocation of a patent on petition to the Court and in an action for infringement, and to the procedure on an application for the registration of a design, which will be repealed as from the date when rules dealing with the matters in question come into operation.

Orders in Council, rules, and tables of fees now in force are not, however, repealed, but it should be noted that, under the schedule of fees to the Act rules may be made according to which the cost of renewal may be increased, so that, at most, fifty pounds may be charged for the renewal of a patent before the end of four years, and a further hundred pounds for its renewal before the end of eight years from the date of the patent, or, in lieu of the fifty and hundred pounds just mentioned, an annual fee of ten pounds before the expiration of the fourth, fifth, sixth, and seventh years, fifteen pounds before the expiration of the eighth and ninth years, and twenty pounds before the expiration of the tenth, eleventh, twelfth, and thirteenth years.

EMIGRATION.

The Statistical Tables relating to emigration from the United Kingdom in 1906 show that the balance outward of British and Irish passengers—which may be taken as roughly representing the number of British and Irish emigrants properly so-called—viz., 194,671, was greater than in any year since 1887. And it is very noticeable that notwithstanding the revolution in land tenure in Ireland caused by the legislation of the last thirty years, and the gradual, and even rapid, conversion of the Irish tenantry into cultivating owners, emigration from Ireland shows few signs of substantial abatement. It is true that the proportion of Irish emigrants to the total of all British and Irish emigration has fallen from 47 per cent. in the quinquennial period 1866-70 to 16 per cent. in 1906. But then the relative populations of England, Scotland, and Ireland must be borne in mind. Whilst the population of England and Scotland has shown continuous and rapid growth that of Ireland has steadily decreased. Last year the total number of Irish emigrants was 52,210, and in 1893 the numbers were almost identical, namely, 52,130. A peculiarity of Irish emigration is the large proportion of women. In each of the years 1893 to 1905 the number of women actually exceeded the number of men, and last year the difference was not great in favour of the men, who numbered 27,420 as against 24,790 females. Again the relatively low proportion of children is noticeable, only 8 per cent. of the outward emigrants, of Irish origin, being children under twelve. Of a total emigration from Scotland of 53,162, 7,716 were children under twelve years of age; of a total emigration from Ireland of 52,210, only 4,103 were children under the same age. The total emigration from England last year was considerably higher—219,765—than in any previous year—in 1905 it was only 170,408—and its percentage of the total from the United Kingdom—68 per cent.—exceeded that of any previous year by 3 per cent. For the first time since these statistics began to be compiled, the number of Scotch emigrants was larger than the number of Irish—53,162 as against 52,210.

As to the destination of the emigrants, it should be remembered that the information which the Board of Trade have the statutory power to obtain only shows the places at which the emigrants propose to disembark, and not necessarily their ultimate destination. It is known that a large number of emigrants who contract to land at ports in British North America, proceed immediately to the United States, and that, on the other hand, many of those who contract to land at United States ports, proceed at once to British North America. The voluntary returns supplied to the Board of Trade by the courtesy of the various shipping companies lead to the conclusion that the statutory returns under-estimate the number of British emigrants to British North America. The British and Irish emigration to British North America has increased from 18,443, or 11 per cent., in 1900, to 114,859, or 35 per cent., in 1906, whereas the emigra-

tion to Australasia has fallen proportionately from 14,922, or 9 per cent., in 1900, to 19,331, or 6 per cent., in 1906. To the Cape of Good Hope, taking the same period, the figures are 20,815 and 22,804, the percentage falling from 12 to 7. Turning to occupations, the following figures show the occupations of the male emigrants from the United Kingdom in 1906:—Agricultural, 25,473; commercial and professional, 17,612; skilled trades, 39,285; labourers, 50,544. And of females the occupations of the majority were—Domestic and other service, 22,617; dressmakers and other trades, 3,392; teachers, clerks, and professions, 1,656; no stated occupation, 77,474.

Table No. 5 gives some suggestive figures as to emigration to the United States. Twenty years ago of a total emigration to that country of 334,203, 112,539 came from the United Kingdom. In 1906 the total had risen to 1,100,735, and of these only 102,193 came from the United Kingdom. But if the proportion of British emigrants to the United States has shrunk from about 1 in 3 to less than 1 in 10 the shrinkage in German emigration is even more remarkable. In 1886 84,403 emigrants went to the United States from Germany, in 1906 only 37,564. So with Sweden, Norway and Denmark. In 1886 the total number of emigrants was 46,735, in 1906 it was indeed larger but not much at 52,781. On the other hand, taking the same years, the Italian emigration increased from 21,315 to 273,120; the Austro-Hungarian from 28,680 to 265,138; the Russian and Poles from 21,739 to 215,665. These figures show the profound change in the character of the emigration to the United States during the last twenty years, a change that Americans can hardly look upon with anything approaching satisfaction. The number of emigrants rejected by the United States in 1906 was 446, "paupers or likely to become a public charge" accounting for 286 of them, and "idiocy or insanity" for 97 of the remainder.

OUT-DOOR ADVERTISING IN BRAZIL.

In Brazil, it may be said generally, that anything which can be made to produce a municipal revenue is employed to that end. For instance, the financial estimate of the municipality of Rio de Janeiro for the current year includes revenues from a tax on salaries of officials, revision of house numbers, wagon weighing tax, registration of cows, domestic servant tax, tax on unoccupied building sites, fines for infractions of contracts, &c. Among such estimates are those for rent and licences of kiosks, and advertisement and door-plate tax, which concern out-door advertising. Every sign in Rio is taxed. The American Consul there says that the proprietor of a café, having a special *sorvete*, or ice, to serve, makes a placard and hangs it to a door-post, or to one of the palm trees in tubs which commonly decorate such establishments. The notice thus posted must have a revenue stamp attached. Permanent signs are taxed on a permanent basis, temporary signs on a stamp basis. A sign "house to be let," bears a revenue stamp. Under such circumstances the tax on sign-boards or bill-boards is the expected thing, but naturally there is much less general use of such forms of advertising. As in cities in England and the United States, a vacant corner in a frequented street is very likely to have some sort of a bill-board arrangement, and temporary hoardings about buildings in course of construction are generally covered with more or less prominent advertisements, but these advertisements being taxed, are regulated both in size and other respects. Since it costs in Brazil a good deal in the way of taxes, as well as in the preparation of boards, for the purpose of such advertisements, there are very few of them to be found. The outdoor signs are, as a rule, painted signs, and in general it may be said that they represent the best form of poster or billboard advertising. Theoretically, anyone can erect outdoor signs, subject to the approval of the prefect or mayor of the municipality and paying the tax, but practically the erection of such signs is almost altogether in the control of a company which has taken possession of the most available sites for such work. In a large number of suitable positions in parks, pleasure resorts, vacant street corners and elsewhere, kiosks have been erected for the sale of light refreshments, and these structures are taken advantage of for advertising purposes. As a rule, the kiosk privilege carries with it the advertising privilege. There are also in the various streets and avenues small movable kiosks, often of so light a construction that the proprietor carries it about with him, goods and all. These are also licensed by the municipality and generally carry advertising matter. In the way of electric signs there is practically nothing to be seen in most Brazilian cities. The consul says that he does not know of a single electric sign in Rio de Janeiro, but it is probable that as soon as the new electric light and power service is effective there will be a change, and that regulations will be modified to meet changed conditions. In Sao Paulo, in some respects the most up-to-date city in Brazil, there is plenty of electrical current to be had at comparatively low rates, and electric signs are commencing to appear.

THE MINERAL INDUSTRIES OF CANADA.

According to the "Annual Report on the Mineral Industries of Canada," recently issued by the Geological Survey of Canada, the great total of the mineral production of the Dominion in 1905 was valued at £14,500,000. In 1904, as compared with 1903, there was a shrinkage of about 2·7 per cent., and not only has this falling off been made up, but the increase in 1905 over 1904 amounts nearly to £2,000,000, or about 16 per cent. The uniform basis of valuation adopted enables a comparison to be made, and it is found that the total for the year 1905 is just about 8,300,000 greater than in 1895, or

a growth of 200 per cent. Substantial increases in 1905, as compared with 1904, are shown by all the leading mineral industries, except in the case of gold, in which a very considerable falling off has to be recorded. This is altogether due to the continued decrease in the production of the Yucon placers, which has been continuous now for some years. This shrinkage has been offset by increases in all the other gold mining districts of the country, amounting to about £62,000. The actual gold output of Canada in 1905 was valued at £3,041,000, as compared with £3,430,000 in 1904—a decrease of 11 25 per cent. The gold production has steadily decreased since 1900, when a maximum output of £5,800,000 was reached, the falling off being due in the main to the gradual lessening of the output of the Yukon placer deposits, which reached their highest production in the year mentioned. The other gold-producing districts of Canada all show increases on 1905. Of the total output 57 per cent. was derived from the Yukon district, and 96 per cent. from the Yucon and British Columbia combined. Nearly 64 per cent. of the whole was obtained from placer and hydraulic working, &c., and 36 per cent. from lode mining. The quantity of gold produced by provinces and districts in 1905 was as follows:—North-West Territories, Yukon district, 402,864 ounces fine; Saskatchewan River, 121; British Columbia, 285,554; Nova Scotia, 13,708; Quebec, 191; and Ontario, 4,403, making a total of 706,841 ounces fine, valued, as stated above, at £3,041,000. Silver is produced in Canada in the provinces of Quebec, Ontario, and British Columbia, and a certain quantity is also recovered from the placer-gold found in the Yukon. The total output in Canada in 1905 was 5,994,292 ounces, valued at £753,000, an increase in quantity of 2,416,766 ounces, or 67 per cent., and in value of £327,000, or 76 per cent. compared with the output in 1904. This large increase is due in a measure to the doubling of the output of argentiferous lead ore from East Kootenay, British Columbia, but chiefly to a large output from the recently opened up native silver deposits at Cobalt, Ontario. Since 1894 the argentiferous lead ores of British Columbia have been responsible for the greater part of the silver output in Canada, over 90 per cent. being obtained from that province. In 1905, however, the large silver production at Cobalt, Ontario, has somewhat reduced the relative importance of the western province in the total output. The proportions in that year were Ontario nearly 41 per cent., British Columbia 57 per cent. The most valuable of the mineral assets of Canada is coal, which stands pre-eminent; and if to this be added the other fuel items, viz., petroleum and natural gas, 27 per cent. of the total mineral production is accounted for. For the year ending December 31, 1905, Canada's coal production amounted to 8,667,948 tons, valued at £650,000, to which Nova Scotia contributed 5,646,583 tons; British Columbia, 1,945,452 tons; North-West Territories, including Yukon, 1,046,513 tons, and New Brunswick, 29,400 tons. The new provinces of Alberta and Saskatchewan have been advancing, as coal producers, at a very rapid rate. Nova Scotia has remained practically stationary since 1903, while in New Brunswick the coal industry has shown signs of great activity as compared with previous years. Here the production has increased from 9,000 tons in 1904 to over 29,000 tons in 1905. Of copper, the total amount produced in 1905 was 48,092,753 pounds, valued at £1,600,000, and this is the highest output yet recorded, being an increase over 1904 of 6,709,031 pounds, or 16·21 per cent., and more than twice the output of any year previous to 1901. The production by provinces was as follows:—Quebec, 1,621,243 pounds; Ontario, 8,779,259, and British Columbia, 37,692,251 pounds. It will thus be seen that of the total output, British Columbia contributed in 1905 over 78 per cent., Ontario over 18 per cent., and Quebec a little over 3 per cent. The production of lead showed a total output in 1905 of 56,864,915 pounds, as compared with 37,531,244 pounds in 1904, an increase of 19,333,671 pounds, or 51 per cent. The high price of refined lead on the New York market during 1905, together with the bounty paid in Canada on the production of lead ores, no doubt stimulated the production of the metal, although the output was not as great as was attained in 1900, when 63,169,821 were produced without the assistance of any bounty, and when the price of lead was lower than during 1905. The whole of the output of lead in 1905 was derived from mines in British Columbia, with the exception a small amount which was mined in Ontario. The production of nickel (contents of matte shipped) from the copper nickel ores of the Sudbury district of Ontario, reached a total of 18,876,315 pounds in 1905, the largest output ever reached in the district, being more than twice the production of 1901, and an increase of 8,328,432 pounds, or nearly 79 per cent. over 1904. The value of the production was £1,573,000. Asbestos was produced to the extent of 50,669 tons, valued at £310,000, and asbestic 17,594 tons, valued at £3,500. According to the returns, there are three main grades of the product, viz., crude, mill-stock, and asbestic. The former represents the portions of clean fibre picked out by hand; the mill-stock, as its name implies, represents a number of different products of the milling process; whilst the by-product, for which the name asbestic has been adopted, consists of the residual serpentine sand, carrying a large proportion of very short fibre. This finds a sale for plastering and other uses, taking the place of the ordinary sand and hair, over which it is claimed to have many advantages. The asbestos fibre is sold to manufacturers, who produce with it a great variety of finished articles, millboard paper, woven goods, &c., for use, where a fireproof and non-conducting material is called for. The asbestos product of Canada comes altogether from one small district in the eastern townships of Quebec province.

HOME INDUSTRIES.

Capital and British Railways.—The Blue-book on the Railways of the United Kingdom during the year 1906, just published, shows that the increase in the authorised capital of British railway companies during the year was very much the lowest on record, being only, in round figures, £2,500,000 sterling. The previous minimum was £7,600,000 in 1885. The total capital invested in British railways at the end of 1906 was £1,286,900,000. It may be assumed that the very slight increase in capital during 1906 was mainly due to the adverse condition of the money market, but also to a growing caution in expenditure on new works which is noticeable in the management of most of the great railway companies.

Cotton Production.—It is not surprising that the Lancashire cotton spinners who have been travelling through the Cotton States have found the planters and others desirous to satisfy them that they need not go further afield for their cotton supplies, and that the Southern States of America can easily meet the world's growing demand for cotton. At many gatherings this was emphasised in American speeches, and supported by undisputed statistics. For example, Governor Hoke Smith, when welcoming the Lancashire spinners in Atlanta, said that less than one-fifth of the land of the State is in cultivation and not more than half of that in cultivation is in cotton. "We ask," said the Governor, "your attention to our claim, that while cotton may be grown with partial success in many countries of the world, yet nature has intended this to be the permanent section for the growth of cotton in its perfection. This is not due to better knowledge of the culture, but to a combination of soil and climate that exists nowhere else. . . . . You can rely upon our cotton belt to furnish a supply as a permanent proposition to meet your ever-increasing demand." Granted that cotton cannot be grown elsewhere in such perfection as in America —a proposition by no means demonstrated—and that the Southern States can continue to meet the requirements of the world, the reasons which led to the formation of the British Cotton Growing Association remain. It may be true that only a comparatively small area of land in the South is under cotton cultivation, that enormous areas are still available for the staple, and that the South can produce all the cotton the world can require. Lancashire can never feel really safe whilst she has to depend so largely as she does to-day upon a single country for the raw material of her leading industry. The livelihood of 2,500,000 people is involved in getting raw cotton at prices not above certain figures, and only four years ago Lancashire was suffering from the high price of cotton, which compelled the reduction of working hours from 55½ to 40 a week, a reduction that continued for nearly a year. Any day there may be a repetition of these fictitious figures whilst the sources of supply remain so limited as at present. The cultivation of cotton is steadily spreading within the Empire, and although the expansion is less rapid than might be wished, it is continuous, and in encouraging and assisting it, the British Cotton Growing Association is doing a national work of great value.

Marine Engineering in London.—Messrs. Humphrys and Tennant, of Deptford Pier Works, have decided to follow Messrs. Yarrow in closing their establishment upon the Thames when present orders are completed. Messrs. Humphrys and Tennant have maintained their position in the front rank of marine engineering until the end. Their last Admiralty contract, now nearly completed, has been for the turbine machinery and water-tube boilers of the *Invincible*, building at Elswick. The power to be developed exceeds 40,000 horse-power. Whilst Messrs. Humphrys' work has been most closely associated with the Royal Navy, they have done important work for the mercantile marine. Their retirement from the Thames is due, as was that of the Messrs. Yarrow, to their conviction that the time has come when the struggle to maintain their place in competition with other firms more favourably situated, is not worth continuing. In a letter to *The Times* they point out the causes which have led them to their decision. (1) Wages are much higher in London than in any other district in Great Britain. (2) Coal and material cost much more. (3) Rates are much higher. Perhaps, they say, the first and third of these are the more important from an engineer's point of view. Wages are higher now than they have ever been, and may be said to be abnormally high. Rates also are much higher. Messrs. Humphrys, Tennant and Co. allege that London municipal authorities "fail to grasp the importance of doing what they can to assist industrial enterprises which are the source of very great benefit to the district in which they are situated; they seem to be imbued with the idea that the more they can extract from the unfortunate employer the better. Take for example their action during the last quinquennial assessment, when, making use of the vagueness of the wording of the law relating to assessment of machinery, they very largely increased all assessments and so placed an additional burden upon the users— in our case amounting to over 33 per cent. on one assessment and over 50 per cent. on another." There may be a sufficient answer to these complaints, but the fact remains that the great engineering firms are leaving the London district, and that the continuance of this migration must be a very serious matter for London workmen, not to speak of other sections of the community.

Iron and Steel Production and Consumption.—The annual return of the Board of Trade showing the consumption and production of iron and steel in the United Kingdom and the principal foreign countries in recent years has just been issued. Practically complete information is given for 16 years to 1905, and

in many cases it has also been possible to give figures for 1906. The total output of iron ore in the world amounted in 1905 to about 114 million tons, the principal producers being the United States, Germany, and the United Kingdom. In that year the total production of the United States was 42,520,000 tons, of Germany 23,067,000 tons, and of the United Kingdom of 14,591,000. The preliminary figures so far available for 1906 indicate a further large increase in the output of the United States, the total being rather under 50 million tons, or 7 million tons more than in 1905. In Germany there was an increase of over 3 million tons, and in the United Kingdom of one million. The total quantity of pig iron produced in the world in 1905 amounted to about 55½ million tons, the principal producers being the same three countries in the order named above, the three together accounting for about four-fifths of the total output of the world. The total production of the United States was 22,992,000 tons, of Germany 10,700,000 tons, and of the United Kingdom 9,608,000 tons. During 1905 the production of the United States increased by no less than 6½ million tons, the production of the United Kingdom and Germany increasing by 900,000 tons and 800,000 tons respectively. The preliminary figures so far available for 1906 indicate that in that year there was an increase of 540,000 tons in the production of the United Kingdom; of 1,400,000 tons in the production of Germany; and of over 2¼ million tons in the production of the United States. At present the greater proportion of the pig iron consumed is utilised in the production of steel, the use of steel having increased very markedly in recent years. The total steel production of the world in 1905 was about 43,000,000 tons, of which 20,024,000 tons must be credited to the United States, 9,905,000 to Germany, and only 5,812,000 to the United Kingdom. Preliminary figures for 1906 indicate there was a further large increase in the production of the United States, which reached about 23,750,000 tons, whilst the production of Germany increased by about a million tons, and that of the United Kingdom by about two-thirds of a million tons.

Merchant Shipping.—Some indication of the enormous growth of shipping enterprise during the last half century may be gathered from a return just issued by the Board of Trade, and which shows that the total tonnage of sailing and steam vessels of different nationalities entered and cleared in the foreign trade at ports in the United Kingdom increased from 24,690,000 tons in 1860 to 120,790,000 tons in 1906. The proportion of British tonnage to the whole during this period of nearly fifty years has not varied very greatly. It ranges from 56·4 to 72·9 per cent., while the latest figures available give a proportion of 63·3 per cent. During the same time the total tonnage of the merchant navies of the British Empire, including the Colonies, has advanced from 5,711,000 tons to 12,791,000 tons. No other country has exhibited a similar expansion, but Germany shows a slightly larger relative increase. Since 1870 the German mercantile fleet has increased from 982,000 tons to 2,515,000 tons. On the other hand, the tonnage of ships registered in the United States for over sea traffic has shown a remarkable decrease, amounting to no more than 939,000 tons in 1906 as compared with 2,546,000 in 1864. That Great Britain is still maintaining her supremacy is also shown by the record of gross additions to tonnage, which, in the case of the United Kingdom amounted last year to 954,000 tons, the next largest total being furnished by the United States, which added 418,000 tons, including, however, barges and canal boats. On the whole, the figures given in the Return show that Great Britain is holding her own in this department of industry; but there is an unsatisfactory feature, namely, the increasing proportion of foreigners (exclusive of Lascars) employed on British ships. The total in 1906 was 38,000, against 188,000 British subjects, the proportion being 20·22 per cent., a slightly lower percentage indeed than that of 1903, when the proportion was 22·88 per cent., but a great advance upon the figures for earlier years.

The Wheat Trade.—Not only are the present high prices for wheat likely to be maintained, the indications point to enhanced values. There was indeed a decline in American values last week of from 1s. to 1s. 6d. per quarter, but this was due almost entirely to financial panic there. America will have comparatively only a small surplus for export, and much of it has already come over. Between August 1 and September 24 last we received from the United States and Canada 5,930,000 quarters, as against 5,660,000 quarters in the corresponding period of last year, and this notwithstanding the smaller available surplus this year. The explanation may be found in the high prices and monetary stringency. The shipments from Russia and the Danubian ports show a great falling off. Taking the same period they amounted for the present year to only 4,925,000 qrs. as against 6,400,000 qrs. in the corresponding period of 1906, and 10,150,000 qrs. in 1905. Only comparatively small supplies are to be expected from Russia this season, and up to the present the supplies from Argentina have been very small only (taking the same period as above) 620,000 qrs. as against 975,000 qrs. in 1906 and 1,900,000 qrs. in 1905. Advices from Australia make it very doubtful whether there will be any surplus for export to Europe. It seems certain, therefore, that home farmers who can hold their wheat will be the gainers, for nearly every wheat-producing country in the world seems to have had abnormal weather conditions this year, causing, of course, a widespread shortage. Usually when the supplies from one country run short an abundance in another makes up the deficiency, but the United States, Canada, Russia, India, Australasia, all are short,

Argentina being the one possible exception, and there the harvest has still to be gathered. And it is to be noted that whilst harvests in Europe have been poor, there is a growing demand on the Continent for wheat flour. The labouring classes in Continental cities are beginning to show preference for white bread to the dark bread made years ago, and growing prosperity is enabling some of them to indulge in the preference.

GENERAL NOTES.

British Trade with Florence.—Commenting upon the trade and commerce of Florence Major Chapman, His Majesty's Consul-General refers (Cd. 3727-9) to one reason why German and other foreign houses seem to be making headway when he says that British houses with few exceptions still insist on terms which are no longer acceptable, as for instance, requiring payment on consignment on home steamer or at station of departure, and sometimes insisting on payment of invoice before consignment, even when dealing with well-known firms. The United States and Germany—especially the latter—are much more liberal in their conditions. British firms should also, in the opinion of the Consul-General, relieve purchasers of the surprises of charges for insurance, transport, freight, customs, &c., as it is better for them to calculate these charges at the place of shipment than to burden the receiver with documents which he finds it difficult to understand, and which do not enable him to check expenses. By so doing, and making reasonable prices, British firms would, the Consul-General thinks, be able to push their manufactures to a much larger extent.

Commercial Travellers in Pernambuco.—In reporting upon the trade and commerce of Pernambuco, Mr. Consul Stanforth (Cd. 3727-5) lays stress upon the need for "suitable representation" if British trade is to be maintained and increased. The number of German travellers who regularly visit Pernambuco greatly exceeds the total number of travellers from all other countries. The Germans secure a large number of orders, and do a very satisfactory business, much of which might be secured, the Consul thinks, by British exporters if they were better represented. Something like half these German travellers represent Hamburg houses dealing in Manchester cotton goods, for which there is a large demand in the district, and it would appear that if the orders were secured direct by British travellers the intermediate profit which now goes to make up so large a proportion of German business in Pernambuco might be secured to British exporters. The same consideration would appear to apply to articles of German manufacture, with which British firms should, in many cases, be able to compete with every chance of success. Other things being equal British manufactures are much preferred by buyers in Pernambuco to those of German or any other origin. The Consul says that not only should commercial travellers have some knowledge of the language, they should be of "agreeable manners and presence, which qualifications possess in Pernambuco a value far beyond what is usually attached to them in ordinary matters of business." The Consul points out, too, that it is very desirable that British exporters to Pernambuco should use only the metric system in their quotations, dealings, and correspondence with import houses there. Brazilians do not understand British weights and measures, and will not take the trouble to convert them; rather than do so they will place their orders elsewhere. The success of German commercial travellers in selling British manufactured goods on behalf of Hamburg houses is to some extent due to their always using the metric system. British exporters should also bear in mind that every Consular invoice should accurately state the contents of each case or package sent to Pernambuco, giving the exact weight and quantity of every article it contains, as well as the material of which it is manufactured. And it must be in accordance with instructions obtained from the Brazilian consulates.

MEETINGS FOR THE ENSUING WEEK.

Monday, Nov. 11...Surveyors, 12, Great George-street, S.W., 8 p.m. Opening address by the President, Mr. Thomas Taylor Wainwright.

Geographical. University of London, Burlington-gardens, W., 8½ p.m. Mr. J. Mackintosh Bell, "The great Douglas Glacier of New Zealand and its neighbourhood."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. F. Hamilton Jackson, "Romanesque Ornaments."

Tuesday, Nov. 12...Asiatic, 22, Albemarle-street, W., 4 p.m. Sir H. Mortimer Durand, "Nadir Shah."

Civil Engineers, 25, Great George-street, S.W., 8 p.m. Mr. H. T. Ker, "The Extension, Widening, and Strengthening of Folkestone Pier."

Photographic, 66, Russell-square, W.C., 8 p.m. Discussion on "The Best Methods of Advancing the Study of Photography in Colours."

Colonial, Whitehall Rooms, Whitehall-place, S.W., 8 p.m. Mr. R. Jebb, "Twelve Months of Imperial Evolution."

Wednesday, Nov. 13...United Service Institution, Whitehall, S.W., 3 p.m. Captain C. W. Battine, "The Use of the Horse Soldier in the Twentieth Century."

Thursday, Nov. 14...Junior Art Workers' Guild, Clifford's Inn-hall, Fleet-street, E.C., 8 p.m. Mr. Penty, "The Economics of Craftsmanship."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. H. Hill, "The Mind of the Ant."

Friday, Nov. 15...Art Workers' Guild, Clifford's Inn-hall, Fleet-street, E.C., 8 p.m. Paper on "Cups and Flagons."

Architectural Association, 18, Tufton-street, S.W., 7½ p.m. Messrs Gibson and Greenwood, "The Relations between the Architect and the Builder."

Mechanical Engineers, Storey's-gate, Westminster, S.W., 8 p.m. Mr. Edward J. Way, "Labour-saving Appliances at the Mines of the New Kleinfontein Co., Transvaal."

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FRIDAY, NOVEMBER 15, 1907.

All communications for the Society should be addressed to the Secretary, John-street, Adelphi, W.C.

NOTICES.

H.I.M. THE GERMAN EMPEROR.

At the request of the Council, H.R.H. the Prince of Wales, as President of the Society, graciously invited H.I.M. the German Emperor to become an Honorary Royal Member, and he has now received from His Imperial Majesty the following letter of acceptance :—

Windsor Castle,
12th November, 1907.

SIR,—I have had the honour to receive the letter of November 4th, in which Your Royal Highness asks me to accept the Honorary Royal Membership of the Society of Arts, of which Your Royal Highness is President.

The Society of Arts is an Institution whose work and objects are well known to me, and have always commanded my interest and sincere appreciation. It is with very great pleasure that I accept Your Royal Highness's proposal that my name be added to the list of those Sovereigns who are Honorary Royal Members of the Society, and I beg to thank Your Royal Highness for this mark of kind attention.

I have the honour to be, Sir,
Of Your Royal Highness
the sincerest affectionate cousin and friend,
(Signed) WILLIAM I.R.

ARRANGEMENTS FOR THE SESSION.

The Opening Meeting of the One-hundred-and-Fifty-Fourth Session will be held on Wednesday Evening, the 20th of November, when an Address will be delivered by Sir STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Vice-President and Chairman of the Council. The Chair will be taken at 8 o'clock. The subject of the Address will be "Lord Clive, and his part in the foundation of the Indian Empire."

Previous to Christmas there will be five Ordinary Meetings, one meeting of the Indian Section, and one of the Applied Art Section.

The following arrangements have been made :—

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock :—

NOVEMBER 27.—"The Franco-British Exhibition, 1908." By THE HON SIR JOHN A. COCKBURN, K.C.M.G. THE RIGHT HON. VISCOUNT SELBY will preside.

DECEMBER 4.—"Old Age Pensions." By Sir EDWARD W. BRABROOK, C.B. SIR WILLIAM BOUSFIELD, LL.D., Member of the Council, will preside.

DECEMBER 11.—"Radio-active Phenomena." (Aldred Lecture.) By SIR WILLIAM RAMSAY, K.C.B., F.R.S. SIR STEUART COLVIN BAYLEY, K.C.S.I., C.I.E., Chairman of the Council, will preside.

DECEMBER 18.—"The Rôle of France in West Africa." By MONSIEUR LUCIEN HUBERT, Député des Ardennes.

INDIAN SECTION.

Thursday afternoon, at 4.30 o'clock :—

DECEMBER 12.—"Big Game in India." By REGINALD GILBERT, F.Z.S., late of Bombay.

APPLIED ART SECTION.

Tuesday evening, at 8 o'clock :—

DECEMBER 17.—"How to Make the Most of a Museum." By LEWIS FOREMAN DAY, F.S.A. SIR ASTON WEBB, R.A., F.R.I.B.A., will preside.

SHAW LECTURES ON INDUSTRIAL HYGIENE.

Friday evenings, at 8 o'clock :—

NOVEMBER 29.—The Hygiene of Work in Compressed Air (Diving, Caisson Work, Sub-aqueous Tunnelling, &c.). By JOHN SCOTT HALDANE, M.A., M.D., M.R.C.P. (Edin.), F.R.S. HERBERT LOUIS SAMUEL, M.P., Under-Secretary of State for the Home Department, will preside.

DECEMBER 13.—"Industrial Poisons—Lead and Phosphorus, with special reference to Lucifer Match Making." By PROFESSOR THOMAS OLIVER, M.D.

CANTOR LECTURES.

Monday evenings, at 8 o'clock :—

CONRAD BECK, F.R.M.S., "The Theory of the Microscope." Four Lectures, November 25, December 2, 9, 16.

Meetings after Christmas:—

ORDINARY MEETINGS.

Wednesday evenings, at 8 o'clock (dates not fixed):—

"Screen-Plate Processes of Colour Photography." By C. E. KENNETH MEES, D.Sc., F.C.S.

"The Problem of Road Construction, with a View to Present and Future Requirements." By H. S. HELE-SHAW, LL.D., F.R.S., and DOUGLAS MACKENZIE.

"Recent Improvements in Decorators' Materials." By A. S. JENNINGS.

"The Underground Water Supplies of the Thames Basin." By CLAYTON BEADLE.

"Industrial Entomology: the Economic Importance of a Study of Insect Life." By F. MARTIN DUNCAN.

"Modern Dairy Practice." By LOUDON M. DOUGLAS.

"War Balloons." By AUGUSTE E. GAUDRON.

"Siam and its People." By HARRY HILLMAN.

INDIAN SECTION.

Thursday afternoons, at 4.30 o'clock:—

January 16, February 13, March 12, April 30, May 21.

COLONIAL SECTION.

Tuesday afternoons, at 4.30 o'clock:—

January 28, February 25, March 24, April 7.

APPLIED ART SECTION.

Tuesdays, at 4.30 or 8 o'clock:—

January 21, February 18, March 31, April 28, May 26.

CANTOR LECTURES.

Monday evenings, at 8 o'clock:—

HENRY HARDINGE CUNYNGHAME, C.B., "The Theory and Practice of Clock Making." Six Lectures.

January 20, 27, February 3, 10, 17, 24.

PROFESSOR VIVIAN B. LEWES, "Fuel and its Future." Four Lectures.

March 9, 16, 23, 30.

WILLIAM BURTON, F.C.S., "The Nature and Structure of the Porcelains." Three Lectures.

May 4, 11, 18.

SHAW LECTURES ON INDUSTRIAL HYGIENE.

Dates not fixed:—

"The Removal of Dust and Fumes in Factories." By JOHN SCOTT HALDANE, M.A., M.D., M.R.C.P. (Edin.), F.R.S.

"The Dangers of Coal Dust and their Prevention." By W. E. GARFORTH, President of the Colliery Proprietors' Association of Great Britain.

"The Hygiene of the Pottery Trade." By WILLIAM BURTON, F.C.S., Chairman of the Joint Committee of Pottery Manufacturers of Great Britain.

"Child Workers and Wage Earners." By MISS NETTIE ADLER, Hon. Secretary to the Committee on Wage Earning Children.

HOWARD LECTURES.

Thursday evenings, at 8 o'clock:—

H. S. HELE-SHAW, LL.D., F.R.S., "The Navigation of the Air." Three Lectures.

March 19, 26, April 2.

JUVENILE LECTURES.

Two Lectures suitable for a Juvenile audience will be delivered on Wednesday afternoons, January 1 and 8, 1908, at 5 o'clock, by F. MARTIN DUNCAN, on "The Scientific Applications of the Cinematograph."

PROCEEDINGS OF THE SOCIETY.

THE EXAMINATIONS OF 1907.

The Society of Arts Examinations really commenced in 1857, when simultaneous examinations were held in Huddersfield and London, though a tentative examination was held in London in 1856. In the following year (1858) they were held at 58 different centres, nearly 300 candidates being examined. The numbers grew steadily till 2,160 was reached in 1869. The examination system was the outcome of the Society's Union of Mechanics' Institutions devised by Mr. Harry Chester in 1851. The object of the Union was to encourage the foundation of such Institutions, and to develop the educational facilities which they provided. The examinations were at first held through the agency of Institutions in Union with the Society, and only through their agency. Later on the Institution Centres were supplemented by a number of independent Examination Committees, and eventually such Committees were put on entirely the same footing as the Institution Committees, so that the necessity for the Union practically ceased, as the Institutions themselves changed their character and developed in various indepen-

dent directions. Still many of the most important of the Society's centres are even now associated with London and Provincial Institutions which were at one time, or still are, in Union with the Society of Arts.

The scope of the examinations at first was very wide, and included practically all the subjects of general education, but the field was restricted as other agencies took up various parts of the work. The establishment of the University Local Examinations in 1858 soon led the Society to abandon its purely literary subjects, while the examinations of the Science and Art Department, which commenced in 1861, led to the giving up of the scientific subjects. The result was that only the commercial subjects were retained, with the addition of—for some years—Domestic Economy and —down to the present date—Music. In 1871, when the Society's Council were considering the establishment of a system of Technological Examinations, they passed a resolution to discontinue the general examinations; but, on the application of some of the more important of the institutions in Union, they rescinded this resolution, and determined to continue the examinations for a further period. In 1879 the question of abandoning the examinations again arose, it being thought that the ground was covered by other agencies, and eventually it was decided to abandon them, and accordingly they were abandoned after 1880, no examination being held in 1881. Again, however, some of the Institutions where the examinations had been held protested, and, on further consideration, it was determined to continue the examinations.

Hitherto they had been free, but it was decided that an effort should now be made to make them self-supporting. They were accordingly recommenced in 1882, and a fee of 2s. 6d. was charged to each candidate. This fee is still charged to all candidates in the two higher stages. For a time it was insufficient to meet the costs of the examinations, but as the numbers grew, the fees just paid the expenses, and then produced a small profit. Now, however, with the increased number of stages, they hardly suffice to cover the cost.

No changes of any great importance were made in the system until 1901, when an Elementary Stage was added. This proved extremely popular, nearly 4,000 candidates entering in the first year. The number of candidates in the succeeding years is given in Table F, page 1165. When the examinations were first established, an elementary examination had been organised, the Society providing the material, papers and certificates; but the whole of the work and responsibility of the examinations was carried on by the local institutions. This system was never found very satisfactory, though it was useful when it was first established, and it was abandoned in 1894.

For some time the question had been under consideration of providing an examination of a character rather more advanced than the standard of the Society's general examinations, and in 1905 the system was to a certain extent reorganised, and an Advanced Stage established. Up to that time there had been only one Grade or Stage of each subject, but certificates of three classes were given, the successful candidates being arranged in First, Second, and Third classes. Under the new system adopted in 1905, three Stages were established—Advanced, Intermediate, and Elementary. In the Advanced and Intermediate Stages certificates of two classes are given, while the Elementary is merely a pass examination, and there are certificates only of one class. It was hoped that the standard of the Advanced Stage might be gradually raised so that it might supply the need of a higher standard examination, such as might be taken, for instance, by teachers. Up to the present, however, it has not been found possible, or desirable, to make any definite attempt to raise the standard, although, as the Tables, which will be found a little later on in this report, show, there has been a slight tendency to elevation.

When the examinations were re-organised in 1882, it was determined to offer, in addition to the separate subject certificates, a special certificate in General Commercial Knowledge, to anyone who had qualified, within a certain limited time, in a certain specified number of subjects. That this offer had small attractions to the candidates is shown by the fact that only a single application was made for such a certificate, during the 22 years the offer was open, and then only in the last year of the old system, 1904. In that year such a certificate was awarded to W. R. Richardson, of the Brighton Municipal School of Technology, who alone, so far as can be ascertained, had fulfilled the prescribed conditions. The offer still holds good, under the present system, but there has, as yet, been no single application.

In the Elementary Stage a few such certificates have been awarded, 41 in the eight

examinations which have been held since this Stage was established in 1901.

The examinations this year were held at 397 centres in the week commencing April 15th, and lasted from the Monday until the following Friday. The results were issued at the following dates:—Advanced Stage, July 15th; Intermediate Stage, August 10th; Elementary Stage, September 5th.

The Commercial subjects included, as usual, Book-keeping, Accounting and Banking, Shorthand, Typewriting, Economics, Précis-writing, Commercial Law, Commercial History and Geography, Arithmetic, Handwriting, and Modern Languages. The other subject of examination was Music, divided into Rudiments of Music and Harmony.

There were no changes this year in either the subjects or the details of the examinations. Last year some small alterations were made in the Shorthand examination, and the results of these appear to have been quite satisfactory. The system now appears to work with perfect smoothness, and it is not proposed to make any alterations for next year, the Programme for which was issued a few weeks ago.

As above mentioned, the number of centres at which the examinations are held is 397. Many of these are under the control of public educational authorities, and the Council would be glad to see the number of these increased. Although many of the centres, and some of these not the least important, are at institutions which are of the nature of private adventure schools, it is on the whole more satisfactory for the examinations to be under the control of public bodies, which cannot be supposed to have any interest in the success, or failure, of the candidates examined.

The Society this year awarded 28 Silver and 42 Bronze medals, the former in the Advanced Stage and the latter in the Intermediate. It also gave away money prizes to the value of £105, besides other prizes amounting in all to £30, provided annually by the liberality of the Clothworkers' Company.

At the request of the Army Council, the Council arranged to hold a special annual Examination in Shorthand for soldiers. The first examination was held on March 27th, at twenty-three centres in the United Kingdom, one in India, and two in South Africa. In the Advanced Stage (speed 140 and 120 words per minute), there were 8 candidates, of whom 3 obtained 2nd Class Certificates, and 5 failed. In the Intermediate Stage (100 and 80 words per minute) 32 candidates presented themselves, of whom 14 obtained 1st Class Certificates, 9 2nd Class Certificates, and 9 failed. A similar Examination has been arranged in Typewriting to commence next year.

The total number of candidates at the examinations of 1907 was 21,723 (Advanced, 4,279; Intermediate, 9,752; Elementary, 7,692). This is an increase of 364 upon the 21,359 candidates of 1906. The number of papers worked by these candidates was—Advanced, 4,815; Intermediate, 10,161; Elementary, 8,952. In addition to this there were 641 candidates examined in Music at the same time as those in the Commercial subjects, and 40 Shorthand candidates at the Special Army Examinations. In addition to these again there were 629 candidates in Colloquial Modern Languages, and 457 in the Practice of Music. The total number of candidates who were examined in all subjects by the Society of Arts during the year ending July last, was therefore 22,849.

The progress of the examinations since 1883, when they were re-organised and a fee was first charged, down to the present year, is shown graphically in the diagram on page 1162. The detailed results of the three stages of this year's examinations are shown in Table A page 1163, and the number of papers worked in each subject in 1905, 1906, and 1907 in Table B, page 1164.

The increase in numbers in the past and the current year has been very small. The new system introduced in 1905 resulted in a very large increase, from 17,771 in 1904, to 21,253 in 1905; in 1906, the number grew to 21,359, and this year to 21,723. Taking the number of papers worked, we find in the two upper stages a total of 14,976 this year, against 15,001 last, being a decrease of 89 in the Advanced, with 4,815 papers, and an increase of 64 in the Intermediate with 10,161 papers. In the Elementary Stage 8,952 papers were worked, an increase on last year of 525.

In Stages II. and III., Book-keeping is still the most popular subject, with 5,703 candidates, Shorthand being as usual, second with 4,323. French, which it is satisfactory to note has been steadily growing in popularity of late years, now takes the third place with 1,519 papers, Typewriting, with 925, being fourth. None of the other subjects reach such large figures. 553 candidates took up Arithmetic, 425 German, 322 English, 300 Accounting and Banking, 204 Précis-writing, 238 Commercial Law, and 197 Spanish. None of the other

subjects reached three figures. Hindustani, for which, when it was introduced in 1905, there were two candidates, attracted none this year. There were no candidates in Japanese or Chinese. In Stage III. there were none in Swedish, and only six in Stage II.

In the Elementary Stage the 7,692 candidates worked 8,952 papers, so that, as is always the case, a large proportion of the candidates in this, as in the higher stages, were content with a single subject. Book-keeping attracted the largest number, 2,666; next was Shorthand, 2,253. The next largest subject was French, for which there were 1,016 this year. In Arithmetic there were 1,006, a considerable increase on any previous year. Then comes Typewriting, for which 851 candidates presented themselves; in Handwriting and Correspondence, 575. In German the numbers were 341, Spanish 71. In Commercial Geography 136 candidates entered. Italian attracted 36 entries. In all 5,338 certificates were granted to successful candidates, and there were 3,614 failures.

The general character of the results, and the manner in which the various subjects were dealt with, may be estimated from Tables C and D (page 1164), which show the percentages of failures and successes for all the subjects in the two upper stages for the present year, and from Table E (page 1165), which gives percentages of successes and failures in all three stages for the last three examinations. The number of entries in some of the smaller subjects is insufficient for such calculations to have much value, but the percentages are given for the sake of completeness.

In the Advanced Stage the percentage of First-class is the highest yet reached. On the other hand the Second-class is a little lower, the failures being about the same as last year. The First-class percentage in the Intermediate Stage is higher than before, and that of failures lower. In the Elementary Stage there is also improvement. On the whole, therefore, there is progress.

Table F (page 1165) shows generally the progress of the Elementary Examinations since the foundation of that stage in 1901.

A report on the Practical Examinations in Music has been published in the *Journal*.* 457 candidates were examined—a decrease of 10 as compared with last year. These examinations have been carried on continuously since they were established in 1879 at the suggestion of Dr. Hullah. The numbers have never varied within very wide limits. In the first year 117 candidates were examined, The numbers increased gradually to 276 in 1891, and to 395 in 1895. The largest number yet examined was 566 in 1900.

* See *Journal*, July 26th, 1907, vol. lv., p. 893.

A report on the Vivâ Voce Examinations held this year has already appeared in the *Journal*.* 629 candidates entered—a falling off of 15 as compared with last year. These examinations were started in 1902, when 280 candidates were examined. The numbers rose to 681 in 1905. Since then there has been a slight falling off. Examinations were held in French, German, and Spanish. Last year there were some candidates in Italian. The Examiners all speak well of the results. The numbers in French and in German showed a slight increase, the number of German candidates being higher than in any previous year. In all three subjects the weak point of those Candidates who failed was in dictation. In conversation most of the successful candidates aquitted themselves very creditably, and some even brilliantly.

The examinations in Rudiments of Music and Harmony were carried on as usual at the same time as the commercial examinations, and the results appeared as part of the results of the Intermediate Stage. The total number of candidates was practically the same this year as last, as there was 641 this and 639 last year. There was a trifling increase in the number for Rudiments of Music, for which 413 candidates presented themselves, whereas last year there were 408. In Harmony there was a trifling decrease—228 as compared with 231. Of the 413 candidates in Rudiments of Music, 329 passed and 84 failed. Of the 228 candidates in Harmony, 164 passed and 64 failed. The examiner, on the whole, reports favourably on both sections of the examination.

In conclusion, the attention of both teachers and students may be drawn to the remarks of the various examiners on the results of last year. It will be found that these contain many valuable and helpful suggestions, and the work of the candidates year after year shows that far too little attention is paid to them. Teachers especially should study these remarks, and be guided by them in the instruction they give to their pupils. The remarks of each examiner follow his examination paper in the Programme for 1908.

* See *Journal*, November 1st, 1907, vol. lv., p. 1121.

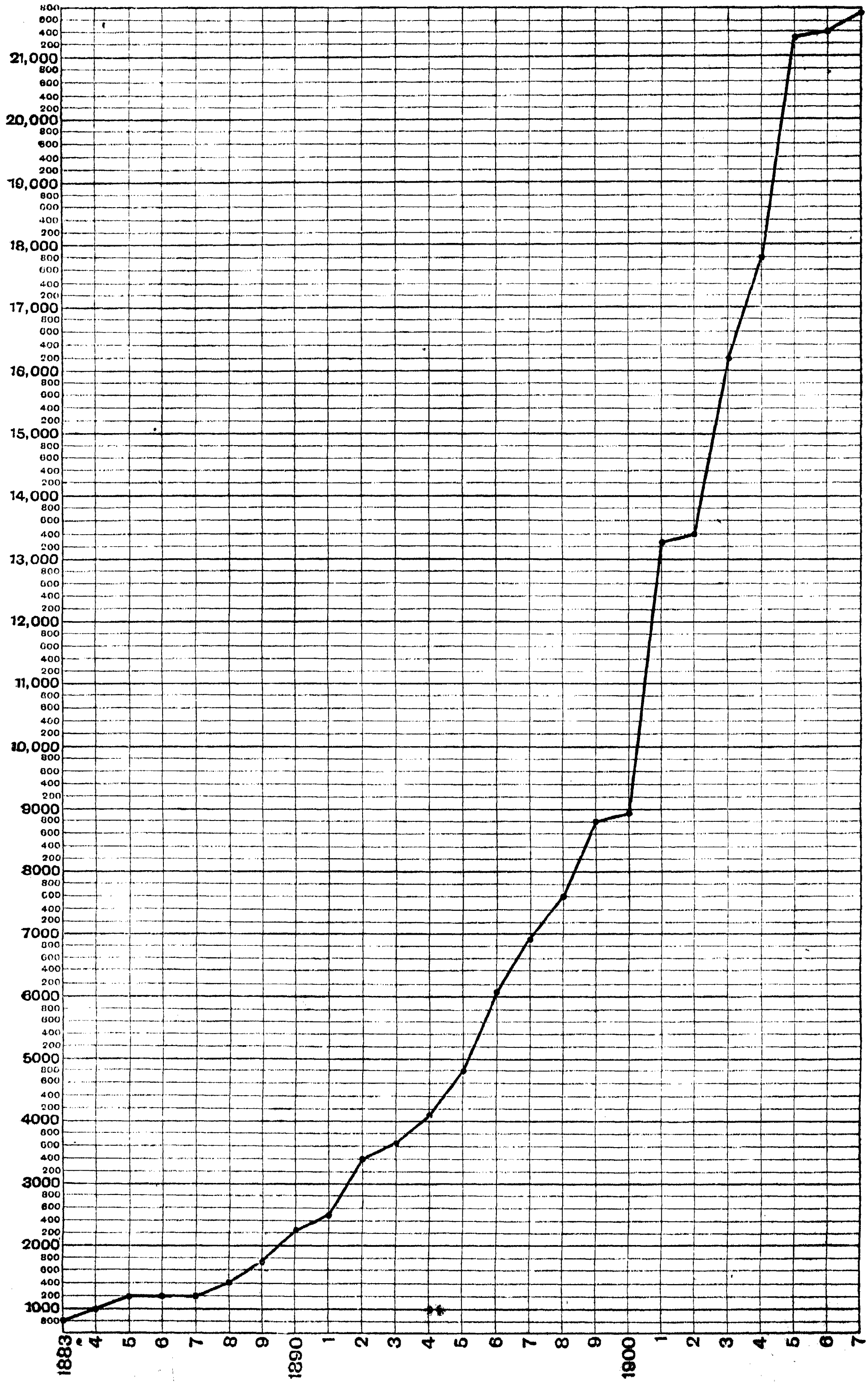

DIAGRAM SHOWING PROGRESS OF EXAMINATIONS, 1883 TO 1907.

TABLE A.—SHOWING THE DETAILED RESULTS OF THE 1907 EXAMINATIONS

Subjects.	Stage III.—Advanced.				Stage II.—Intermediate and Music.							Stage I.—Elementary.		
								Music Certificates.						
	Papers worked.	1st class certificates.	2nd class certificates.	Not passed.	Papers worked.	1st class certificates.	2nd class certificates.	Higher.	Inter-mediate.	Elemen-tary.	Not passed.	Papers worked.	Passed.	Not passed.
Arithmetic	107	21	59	27	446	96	195	..	..	..	155	1,006	667	339
English	60	9	27	24	262	19	148	..	..	..	95	..	..	..
Book-keeping	2,082	176	1,239	667	3,621	520	2,111	..	..	..	990	2,666	1,410	1,256
Commercial History & Geography	28	4	15	9	61	7	23	..	..	..	31	..	..	..
Commercial Geography	..	..	..	..	..	..	..	..	..	..	..	136	100	36
Shorthand	854	180	143	531	3,469	852	1,656	..	..	..	961	2,253	1,355	898
Typewriting	254	60	115	79	671	190	269	..	..	..	212	851	558	293
Economics	59	15	26	18	30	6	16	..	..	..	8	..	..	..
Précis-writing	72	18	24	30	132	30	44	..	..	..	58	..	..	..
Commercial Law	238	25	123	90	..	..	..	..	..	..	..	..	..	..
Accounting and Banking	302	39	165	98	..	..	..	..	..	..	..	..	..	..
French	473	97	232	144	1,046	176	560	..	..	..	310	1,016	653	363
German	152	32	79	41	273	50	126	..	..	..	97	341	166	175
Italian	21	8	10	3	17	7	6	..	..	..	4	30	26	4
Spanish	91	20	39	32	106	24	44	..	..	..	38	78	57	21
Portuguese	15	13	2	..	4	4	..	..	..	..	..	..	..	..
Russian	3	3	..	..	9	2	3	..	..	..	4	..	..	..
Danish and Norwegian	4	1	2	1	8	2	6	..	..	..	..	..	..	..
Swedish	..	..	..	..	6	1	..	..	..	..	5	..	..	..
Handwriting and Correspondence	..	..	..	..	..	..	..	..	..	..	..	575	346	229
Rudiments of Music	..	..	..	..	413	..	..	166	..	163	84	..	..	..
Harmony	..	..	..	..	228	..	..	26	60	78	64	..	..	..
Totals	4,815	721	2,300	1,794	10,802	1,986	5,207	192	60	241	3,116	8,952	5,338	3,614

TABLE B.

NUMBER OF PAPERS WORKED IN EACH SUBJECT IN 1905, 1906, AND 1907.

Subjects.	1905.			1906.			1907.		
	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.	Stage III.—Advanced.	Stage II.—Intermediate.	Totals.
Arithmetic	154	360	514	119	512	631	107	446	553
English	83	235	318	52	282	334	60	262	322
Book-keeping	1,869	3,899	5,768	2,088	3,485	5,573	2,082	3,621	5,703
Commercial History and Geography	48	54	102	31	51	82	28	61	89
Shorthand	1,010	3,343	4,353	783	3,486	4,269	854	3,469	4,323
Typewriting	375	933	1,308	363	780	1,143	254	671	925
Economics	48	33	81	47	59	106	59	30	89
Précis Writing	105	104	209	84	154	238	72	132	204
Commercial Law	169	..	169	224	..	224	238	..	238
Accounting and Banking	208	..	208	322	..	322	302	..	302
French	441	657	1,098	491	872	1,363	473	1,046	1,519
German	180	262	442	167	268	435	152	273	425
Italian	21	12	33	16	30	46	21	17	38
Spanish	94	80	174	89	82	171	91	106	197
Portuguese	28	6	34	17	7	24	15	4	19
Russian	7	10	17	5	9	14	3	9	12
Danish and Norwegian ..	4	..	4	4	5	9	4	8	12
Hindustani	..	2	2	..	..	.	..	..	..
Swedish	..	..	..	2	10	12	..	6	6
Japanese	..	3	3	..	5	5	..	..	..
Totals ..	4,844	9,993	14,837	4,904	10,097	15,001	4,815	10,161	14,976

TABLE C.

PERCENTAGES OF SUCCESSES AND FAILURES, ADVANCED STAGE, 1907.

	First-class.	Second-class.	Failures.
Arithmetic	19·63	55·14	25·23
English	15·00	45·00	40·00
Book-keeping	8·45	59·51	32·04
Commercial History and Geography	14·29	53·57	32·14
Shorthand	21·08	16·74	62·18
Typewriting	23·62	45·28	31·10
Economics	25·42	44·07	30·51
Précis-writing	25·00	33·33	41·67
Commercial Law......	10·50	49·05	30·45
Accounting and Banking	13·25	54·63	32·12
French	20·50	49·05	30·45
German....	21·05	51·95	27·00
Italian	38·00	47·60	14·40
Spanish.............	22·00	42·85	35·15
Portuguese	86·66	13·34	0·00
Russian..	100·00	0·00	0·00
Danish and Norwegian	25·00	50·00	25·00

TABLE D.

PERCENTAGES OF SUCCESSES AND FAILURES, INTERMEDIATE STAGE, 1907.

	First-class.	Second-class.	Failures.
Arithmetic	21·50	45·00	34·50
English	7·25	56·45	36·30
Book-keeping	14·36	58·30	27·34
Commercial History and Geography	11·50	37·70	50·80
Shorthand	24·56	47·74	27·70
Typewriting	28·32	40·09	31·59
Economics	20·00	53·33	26·67
Précis-writing	22·73	33·33	43·94
French	16·82	53·54	29·64
German	18·32	46·15	35·53
Italian	41·15	35·30	23·55
Spanish	22·64	41·52	35·84
Portuguese	100·00	0·00	0·00
Russian	22·22	33·33	44·45
Danish and Norwegian	25·00	75·00	0·00
Swedish	16·67	0·00	83·33

TABLE E.

PERCENTAGES OF SUCCESSES AND FAILURES IN ALL STAGES 1905, 1906, AND 1907.

	1905.		1906.		1907.
Advanced (Stage III.):—					
First-class	14·2	..	12·86	..	15·
Second-class	51·	..	49·92	..	47·8
Failures	34·8	..	37·22	..	37·2
Intermediate (Stage II.):—					
First-class	17·	..	20·77	..	19·45
Second-class	50·4	..	47·32	..	51.25
Failures	32·6	..	31·91	..	30·
Elementary (Stage I.):—					
Passes	57·	..	59·39	..	59·62
Failures	43·	..	40·61	..	40·38

TABLE F.

ELEMENTARY EXAMINATIONS, STAGE I.

Year.	No. of candidates.	No. of papers worked.	No. of subjects.
1901	3902	4458	8
1902	4371	4807	8
1903	5382	6020	8
1904	6401	7203	9
1905	7397	8427	10
1906	7425	8537	10
1907	7692	8952	10

THE COMMERCIAL IMPORTANCE OF TUNIS.

Tunis is overwhelmed by the unexpected needs which its riches have created. Originally it was a small agricultural country, depending upon its vines, cereals, and cattle. Everything was done in the least expensive manner, when a series of discoveries transformed Tunis from a strictly agricultural to a mining country. These discoveries commenced with the famous phosphates of Gafsa. Then the sudden rise in the value of zinc rendered the beds of calamine more important. In the neighbourhood of the phosphate beds of Gafsa the mines of Ain-Moulares, which are no less important, have been discovered. Farther north the mines of Kalaat-ed-Senam and of Kalaat-ed-Djerda, which are rather large, have been discovered. Five large iron mines are being worked at Hamennas, Djerissa, Slata, Nëbeur, and Nefzas. Attention is now directed towards the south, where manganese has been found in large quantities between Gafsa and Gäbes. Nothing has been said of the desert country at the extreme south, but the geologists are of the opinion that these mountains, being of the same origin of those at the north, contain the same proportion of minerals. Prospecting parties are being organised to investigate this region. According to the American Consul-General at Marseilles, the characteristic feature of all these mines is their size. It is expected that millions of tons will be extracted from the mines already discovered. Consequently, however far they may be from the sea, the groups which they form are sufficiently rich to justify the construction of a railway. As for the Gafsa mines, a line has been constructed from Mellaoin to Sfax; for the mines of Ain Safra, a line from Rudivef to Sousse is being made; for the mines of Kalaat-ed-Senam and Kalaat-ed-Djerda, a line has been constructed which goes from these points to Tunis, and branches to the mines of Hamennas, Djerissa, and Slatta are to be built; for the mines of Nebeur plans are being made to build a line to Bizerte; and for the mines of Nefzas, another line is being built which will be extended to Tabarka. This represents a railway system of nearly 622 miles built for the mines, which assure an exceptionally good traffic. For the present there is no question of a line to Gabes, but evidently the Tunisian Government has it under consideration, for plans are being made to spend £200,000 at this point, in order to create a deep-water port. The port will naturally relieve the railway. The lines already built are insufficient for the immense traffic. They have been called upon suddenly to handle traffic comparable to that of the largest French lines, and for which they are not properly equipped. The case of the line of Kalaat-ed-Senam is characteristic from this point of view. Four years ago it was built in view of a maximum traffic of 400,000 tons, which it was believed it would never attain. No one foresaw the rapidity with which—the use of it having spread in all European countries—the market for phosphates would increase. No one foresaw the extraordinary demands for iron which were to take place. The two phosphate mines of Kalaat-ed-Senam and Kalaat-ed-Djerda and the two iron mines of Slata and Djerissa, each wish to be assured of the transportation of 300,000 tons of mineral. Furthermore, the last district has shown that in a good year, the regions traversed have 100,000 tons of cereals for exportation. Consequently, this railway has 1,300,000 tons of goods to transport, but this it is impossible to do. The rails are too light, the sidings too few, workshops too small, and the rolling stock insufficient. The Tunis railway station, much too small, is frequently dangerously blocked. The port of Tunis is considered no longer sufficient and its enlargement is advocated. In a report to the Director of Public Works of the Regency, it is shown that Tunis ought to expend, in the next ten years, £5,000,000 in public works, in order to aid in the development of the country, Tunis can obtain £2,000,000 from her ordinary resources, the rest must be secured by means of a loan. The utility of public works was never more evident. The financial condition of the country is so good that each year its budget has been liquidated by large surpluses, which in 1903 exceeded £400,000.

HOME INDUSTRIES.

Textile Machinery.—The exports of British textile machinery last month show continual progress in value. The total for October, according to the Board of Trade returns, is £752,526, as against £657,170 for the corresponding month of last year, and £583,883 for October, 1905. The total for the first ten months of the current year is £6,630,155, as against £5,467,880 for the corresponding months of 1906, and £4,495,520 for those of 1905. The gain for the current year shows, therefore, an increased ratio both in the month and in the ten months. The increase is no doubt due in part to the necessary increase of renewals, with the continued increase of plant. Taking last month's exports, those to Germany show the largest increase, the value being £127,281, as against £76,632 in October, 1906. The value of the exports to "Other countries in Europe" has increased from £136,180 to £172,450, but the exports to France show a slight falling off, as do those to the United States. The exports to "Countries in South America" show a large increase, but to British India there is shrinkage from £191,496 to £171,623.

The Motor Industry.—There seems to be a considerable slackening in the demand for motor cars, and many factories in Coventry have been put on short time, large numbers of men being discharged from the offices and works. The condition of the textile machinery and the motor-car industries, says the *Manchester Guardian*, presents an interesting contrast in methods of dealing with a sudden expansion of trade. Two or three years ago the demand for motor-cars suddenly increased at an extraordinary rate. Nearly all the manufacturers, carried away by the boom in their business, hastened to build immense factories to deal with it. As might have been expected, although the demand continued to increase, the rate of increase was by no means kept up, and this year many motor-car makers are left with large stocks of costly cars on their hands. The textile machinists have had a similar rush of orders, but we do not hear of any textile machinery factories being erected four or five times the size of the existing ones. The machinists prefer to extend slowly, and people who want textile machinery must wait until existing works can catch up to their orders. They are not to be caught, as it would seem the motor-car makers have been, with a huge output and a poor demand. It may be stated in this connection that, according to statistics just published, there were 148 strikes and eight lock-outs in the German textile industry last year, which affected 384 establishments, and 76,675 workers. The largest number of strikers at any one time was 29,215. The disputes were all short lived, the duration in the majority of cases being less than a month. The returns give no particulars as to the results of these disputes, but it is known that most of them failed. The German manufacturers are well organised, and when a dispute leads to a strike in one factory a general lock-out usually takes place all over the affected district.

The Iron Trade.—The position of the iron market at the present time is peculiar. There is great depletion of the stocks of crude iron. They are lower than they have been for fifty years. Twenty years ago, according to figures taken from the *Statist*, there were 1,250,000 tons of Scotch G.M.B. in the Glasgow warrant stores where now there are 1,300 tons; there were 650,000 tons of Cleveland No. 3 foundry iron in Middlesbrough warrant stores where to-day there is only 110,000, and where last year there were 700,000 tons. At the end of December last there were 622,000 tons of pig iron in the warrant stores of Glasgow, Middlesbrough, and Cumberland, where to-day there are only 127,000 tons. Yet the price of Cleveland warrants is 10s. to 12s. per ton lower than it was when the stock was over half a million tons. And while Cleveland warrants have come down to about 52s. and even under—as compared with 63s. 6d. when the boom was on—there were sellers last week of three months' iron at 2s. 6d. to 3s. per ton under the "spot" price, a striking indication of the feeling that warrants must come down very heavily before long. And yet there are only 110,000 tons in the warrant store, and there is no excess of Scotch iron. Trade and official statistics continue to show large shipments of iron, and trade reports say that makers are sending out their iron as fast as they can make it. But whatever activity there may be is in connection with the fulfilment of contracts entered into when the boom was on. Little or no business is coming in from anywhere, nor is much expected in the near future. On the contrary, a condition of considerable depression is anticipated. Furnaces and factories are still busy, but they are rapidly completing their orders. The industrial activity in Germany and the United States did much to sustain our markets, but in both countries trade is beginning to decline. But it must be remembered that it does not follow that declining trade will mean immediately corresponding reduction of production of iron in Germany and America, and of production continues whilst home consumption diminishes our markets are likely to be flooded with low quotations of German steel and Belgian ore. On the Tyne and Clyde German ship plates are already pressed for sale at large reductions on the prices of English and Scotch makers; and if they are not being freely bought it is probably because the shipbuilders have already satisfied their present requirements. Then there is the enormous American production which will have to be got rid of. Unless production is cut down sooner and more largely than is anticipated America must be a large exporter of manufactured steel as well as of crude iron. At home, too, activity is rapidly diminishing. In the shipbuilding trade there is great and growing depression. Many yards will be almost or entirely idle during the winter months, and

thousands of hands are being discharged as contracts are being completed. The over-production in the shipping world is telling at last, and the re-action, long foreseen, has arrived. It might perhaps have been delayed a little longer if prices of shipbuilding material had not been so high recently, but it was bound to come, as it must come in all trades where the supply greatly exceeds requirements. It is true that of late steel manufacturers have been much helped by the increased application of steel in house building, but the building trade is in a state of depression from which it is not likely to emerge for some little time to come. The present outlook for the iron trade is much less favourable than it has been for some years past.

Economy in Coal Production. — If a writer who signs himself "An Old Collier," is correct much remains to be done in improving the methods of conveyance of coal from the working face to the bottom of the pit shaft. His contention is that owing to the bad and intricate roads over which it has to be conveyed the production of coal per man employed is much less than it might be, whilst the cost is proportionately greater. "I know," he writes, "instances where seven men and lads work in one gang, but only three of these are at the working face, the other four being required to fill and 'waggon' the coal from the face to the main haulage road. First you very often have to let the waggons down a short brow or bay from the face, then run them from 50 to 300 or 400 yards to a jig-brow; then you may have to follow them and again 'waggon' them on another road, and in some cases they have to be wound up a gradient of one in three or three and a half for a distance of sixty yards. In same places the wheels of the waggons will be scotched; in others the men must exert all their strength to keep the waggons moving. The roofs of the roads are often very low, and the waggons will rub against a few pit-props at one place and against the sides of the 'goff' at other points. The bars supporting the roof have broken here and there, and the roofing has sagged, so that even if it does not catch the waggon, it will catch the piled up coal on the waggon, and worse still, the waggoner's fingers." "An Old Collier" suggests that in addition to the accidents in the haulage roads reported by Inspectors of Mines there are many minor accidents due to neglect of the roads that are unreported. It would be interesting to have the opinion of experienced mine managers upon these allegations and, assuming them to be well founded, why it is that the present system, which must be wasteful as well as dangerous, is continued.

Linoleum Manufacturers and Retailers. — Changes are taking place in the relations of wholesale linoleum houses and their customers. The tendency seems to be to eliminate the middleman in the shape of the wholesale houses, by discontinuing special discounts, and dealing direct with the retail trade. In this the leading linoleum companies are only following the example of the Worcestershire, Yorkshire, and Scotch carpet firms and companies, in refusing any longer to extend special advantages to wholesale houses. These houses are endeavouring to resist the change by approaching Continental makers, mostly German, with the object of supplying foreign makes of floor coverings in place of British, but it is not thought likely that foreign competition will in this trade be a serious factor. The objection to dealing direct in other departments of the textile trade is that it necessitates the opening of a number of small accounts, swelling expenses for travelling and carriage, and increases the risk from bad debts. But it is said that in the case of floor coverings these objections do not exist, because the bulk of the retail furnishing trade is in the hands of a comparatively small number of large retail houses.

The Retail Oil Trade.—A trade journal raises the question whether the tendency to shrinkage in the consumption of oil which has been apparent of late is likely to be permanent or temporary. In both 1905 and 1906 considerably less oil was used, whilst this year there has been little change; lessened receipts of oil from Russia being counterbalanced by larger ones from America. The price during 1905-6 was mostly over sixpence per gallon in barrels at the ports of entry, and this rate is considered by the Trade to be fairly moderate. If burning oil goes much above this limit, the competition of the "slot" gas meter begins to be formidable. During the present winter the wholesale price is expected to range between 7d. and 7½d. for American oils and this is likely to lead to smaller consumption in towns where the slot gas-meter system is in use. The tendency anyway is to use less and less oil for heating and cooking, and probably before long the only large consumption will be in illumination. The quantity of illuminating oil used in Great Britain during twelve months ranges from 150 to 170 million gallons, but in 1903-4 it was nearly 200 million gallons. Any rapid falling off in the consumption would mean a considerable reduction in prices, for producers must get rid of this part of their petroleum products, and the prices obtained for spirit would enable them to sell it a good deal cheaper than they do at present.

GENERAL NOTES.

TANNIC ACID.—There is a large quantity of tannin bark made in Bône (Algeria), and Mr. Vice-Consul Scratchley suggests (Cd. 3727-18) that it might be advantageous to treat the bark so as to extract the tannic acid, and to ship it in the form of extract, instead of sending it away in its natural state. The tannin bark from the cork-wood tree contains about 12 per cent. of acid, but that of the green oak has

only 6 to 7 per cent. If the tannic acid were extracted, a great gain would result in the bulk of the matter shipped. The leaves of the lentisk, or mastic bush, which cover an immense area in the forests, could also, the Vice-Consul says, be treated by the same process. The leaf is sometimes sent away under the name of sumach, which it somewhat resembles. Cork-wood waste having fallen considerably in value, the Vice-Consul suggests that it might be a profitable undertaking to reduce it to a powder and ship it in pressed bales. The powder is much easier to press than the bits of cork of different forms and sizes. As the waste in bags makes a very bulky parcel for little weight, shippers do not care to stow it in the hold unless the freight is high, and the buyers do not like waste to be shipped as a deck cargo.

MALAGA WINES.—Malaga wines, which have an excellent reputation in almost every market of the world, find but an insignificant sale in the United Kingdom. Referring to the point in his report on the trade of Malaga (Cd. 3727-201), Mr. Consul Haggard attributes it to the wines being almost unknown in this country, both as medicinal and dessert wines. In his opinion there is no doubt that were the wine called muscatel (which is made from the same grapes as the raisins of that name) known here it would soon achieve the reputation he thinks it deserves, not only on account of its richness in flavour, but also on account of its medicinal qualities. Besides the Spanish red from the central provinces, of which considerable quantities are shipped from Malaga, a trade is beginning in the dark Malagas, which are giving good results for the colouring of whisky. A steady increase in the export of this wine is perceptible every year. Owing to the rise in prices brought about by the fall in exchange, exports, especially in Spanish reds, have decreased considerably.

MEETINGS FOR THE ENSUING WEEK.

MONDAY, Nov. 18...East India Association, Caxton-hall, Westminster, S.W., 4 p.m. Mr. Welinkar, "The Problems of Higher Education in India."

British Architects, 9, Conduit-street, W., 8 p.m. Mr. Mervyn Macartney, "The Present Condition of St. Paul's Cathedral."

Junior Institution of Engineers, 25, Great George-street, Westminster, 8 p.m. Presidential address by H. Gustave Canet on "The Latest Improvements in French and English Modern Artillery."

London Institution, Finsbury-circus, E.C., 5 p.m. Mr. Eric S. Bruce, "The Coming of the Aeroplane."

TUESDAY, Nov. 19...Statistical (in the ROOMS OF THE SOCIETY OF ARTS, John Street, Adelphi, W.C.), 5 p.m. Presidential address by The Right Hon. Sir Charles W. Dilke, Bart, M.P.

Civil Engineers, 25, Great George-street, S.W., 8 p.m. 1. Discussion on Mr. H. T. Ker's paper, "The Extension, Widening, and Strengthening of Folkestone Pier." 2. S. H. Ellis, "The Tranmere Bay Development Works."

Photographic, 66, Russell-square, W.C., 8 p.m. Mr. E. Seymour, "Flower Photography."

Anthropological, 3, Hanover-square, W., 8½ p.m.

Colonial, Whitehall Rooms, Whitehall-place, S.W., 4½ p.m. Dr. J. M. Bell, "The Mineral Wealth of New Zealand."

WEDNESDAY, Nov. 20...SOCIETY OF ARTS, John-street, Adelphi, W.C., 8 p.m. Opening address of the 154th Session by Sir Steuart Colvin Bayley, Chairman of the Council.

Meteorological, 25, Great George-street, W., 7½ p.m. 1. "The International Balloon Ascents, July 22nd to 27th, 1907." Reports by Mr. W. H. Dines, Mr. J. E. Petavel, Mr. W. A. Harwood, Captain C. H. Ley, and Professor W. E. Thrift. 2. "Discussion of the Meteorological Observation made at the British Kite Stations, 1906-1907." By Miss M. White, Mr. T. V. Pring, and Mr. J. E. Petavel.

Geological, Burlington-house, W., 8 p.m.

Microscopical, 20, Hanover-square, W., 8 p.m. 1. Mr. E. W. Nelson, "François Watkins' Microscope." A reply to Prof. Porter's and Mr. Everitt's criticism upon my paper, "On the Limit of Resolving Power for the Microscope and Telescope." 2. Mr. J. W. Gordon, "Mercury Globules as Test Objects for the Microscope." 3. Mr. E. Moffat, "Light Filters for Photomicrography."

United Service Institute, Whitehall, S.W., 3 p.m. Brig.-Gen. Sir H. S. Rawlinson, "Night Operations."

Entomological, 11, Chandos-street, W., 8 p.m.

THURSDAY, Nov. 21...Royal, Burlington-house, W., 4½ p.m.

Linnean, Burlington-house, W., 8 p.m. 1. Mr. W. C. Worsdell, "Abnormal Structures in Leaves, and their Value in Morphology." 2. Mr. J. G. Otto Tepper, "Specimen Preservation in Australian Museums." 3. Mr. S. G. Dunn, "Revision of the genus *Illigera*, Blume." Exhibitions: Mr. G. W. Anderson, "Luminous Larva from British Guiana." 2. Professor A. Dendy. Living Specimens of *Peripatus* from South Africa. 3. Mr. G. C. Druce, *Linaria Serenaria* and other British Plants.

Chemical, Burlington-house, W., 8½ p.m. 1. Mr. S. P. U. Pickering (*a*) "The Interaction of Metallic Sulphates and Caustic Alkalies." (*b*) "The Chemistry of Bordeaux Mixture." 2. Messrs. M. O. Forster and H. E. Fierz, "Aromatic Azoimides. Part III.—The Naphthylazoimides and their Nitro-derivatives. 3. Messrs. T. M. Lowry and E. H. Magson, "Studies of Dynamic Isomerism. Note on the Action of Carbonyl Chloride as an Agent for Arresting Isomeric Change." 4. Mr. S. P. U. Pickering, "Emulsions." 5. Mr. H. G. Denham, "The Electrometric Measurement of the Hydrolysis of the Salts of Anilinium, Ammonium, Aluminium, Chromium, Thallium, Zinc, Magnesium, Cerium, Thorium, Nickel, and Cobalt."

London Institution, Finsbury-circus, E.C., 6 p.m. Mr. Bryan Corcoran, "St. Olave's, Hart-street, and the Old City Walls."

Historical, Lecture-hall, Field-court, Gray's-inn, W.C., 5 p.m. Professor C. H. Firth, "The Ballad History of Henry VII. and Henry VIII."

Numismatic, 22, Albemarle-street, W., 6½ p.m.

FRIDAY, Nov. 22...Botanic, Inner Circle, Regent's-park, N.W., 3¾ p.m.

Physical, Royal College of Science, South Kensington, S.W., 5 p.m. 1. Mr. S Skinner, "On Singing Sand from New England." 2. Mr. L. Bairstow, "Exhibition of a Micromanometer." 3. Mr. Vernon Boys, "A Diabolo Experiment." 4. Professor H. A. Wilson, "Exhibition of a Gyroscope Illustrating Brennan's Monorailway."

CONTRIBUTIONS TO THE READING-ROOM.

The Council have to acknowledge, with thanks to the Proprietors, the receipt of the following Transactions of Societies and other Periodicals.

TRANSACTIONS, &c.

Aeronautical Society, Journal.
African Society, Journal.
American Academy of Arts and Sciences, Proceedings.
American Chemical Society, Journal.
American Institute of Architects, Bulletin.
American Institute of Electrical Engineers, Transactions.
American Institute of Mining Engineers, Transactions.
American Leather Chemists' Association, Journal.
American Philosophical Society, Proceedings and Transactions.
American Society of Civil Engineers, Transactions.
American Society of Mechanical Engineers, Transactions.
Architectural Association, Journal.
Association of Engineering Societies (American), Journal.
Australian Official Journal of Patents.
Australasian Association for the Advancement of Science, Report.
Bath and West of England Society, Journal.
British Association for the Advancement of Science, Report.
British Dental Association, Journal.
British Fire Prevention Committee, Publications.
British Horological Institute, Horological Journal.
Brussels, Société d'Etudes Coloniales, Bulletin.
———, Travaux Publics de Belgique, Annales.
Canada, Royal Society, Proceedings and Transactions.
Canadian Institute, Transactions.
Canadian Patent Office, Record.
Canadian Society of Civil Engineers, Transactions.
Ceylon, Planters' Association, Year Book.
Chartered Institute of Patent Agents, Transactions.
Chartered Institute of Secretaries Publication, "The Secretary."
Chemical Society, Journal.
Chicago, Western Society of Engineers, Journal.
———, Field Columbian Museum, Publications.
Civil and Mechanical Engineers' Society, Transactions.
Cleveland Institution of Engineers, Proceedings.
Cold Storage and Ice Association, Proceedings.
Cornell University, Physical Review.
East India Association, Journal.
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Geneva, Société des Arts, La Revue Polytechnique.
Geological Society, Quarterly Journal.
Glasgow Philosophical Society, Proceedings.
Haarlem, Koloniaal Museum, Bulletin.
Imperial Department of Agriculture for the West Indies, Publications.
Imperial Institute, Bulletin.
India, Geological Survey, Memoirs and Palæontologia Indica.
——, Government of, Agricultural Ledger.
Indian Meteorological Department, Monthly Weather Review.
Institute of Bankers, Journal.
Institute of Chemistry, Proceedings.
Institution of Civil Engineers, Minutes of Proceedings.
Institution of Civil Engineers of Ireland, Transactions.
Institution of Electrical Engineers, Journal.
Institution of Engineers and Shipbuilders in Scotland, Transactions.
Institution of Gas Engineers, Transactions.
Institution of Mechanical Engineers, Proceedings.
Institution of Mining and Metallurgy, Transactions.
Institution of Naval Architects, Transactions.
International Catalogue of Scientific Literature.
Iron and Steel Institute, Journal.
Japan, College of Science, Imperial University, Journal.
Japan Society, Transactions and Proceedings.
Junior Institution of Engineers, Record of Transactions.
Kew Gardens Bulletin.
Lima, Cuerpo de Ingenieros de Minas, Boletin.
Linnæan Society, Journal.
Liverpool, Engineering Society, Transactions.
———, Institute of Tropical Research, Journal.
——— Literary and Philosophical Society, Proceedings.
London Chamber of Commerce, Journal.

Manchester Literary and Philosophical Society, Memoirs and Proceedings.
———— Steam Users' Association, Reports.
Milan, Associazione Elettrotecnica Italiana, Atti.
Munich, Polytechnische - Verein, Bayerisches Industrie-und-Gewerbeblatt.
National Indian Association, "The Indian Magazine and Review."
National Service League, Journal.
New South Wales, Institute of Architects, Journal.
————, Royal Society, Journal and Proceedings.
New York Academy of Sciences, Annals and Memoirs.
North-East Coast Institution of Engineers and Shipbuilders, Transactions.
Nova Scotian Institute of Science, Transactions.
Odontological Society, Transactions.
Paris, Comité International des Poids et Mesures, Procès Verbaux.
——, Conservatoire National des Arts et Métiers, Annales.
——, Société d'Encouragement pour l'Industrie Nationale, Bulletin.
——, Société de Geographie Commerciale, Bulletin.
——, Société des Ingénieurs Civils, Mémoires.
——, Société Internationale des Electriciens Bulletin.
——, Société Nationale d'Acclimatation de France, Bulletin.
Patent-office, Illustrated Official Journal.
Pennsylvania (Western), Engineers' Society of, Proceedings.
Pharmaceutical Society, The Pharmaceutical Journal.
Philadelphia, Academy of Natural Sciences, Proceedings.
———— Engineers' Club, Proceedings.
Physical Society, Proceedings.
Quekett Microscopical Club, Journal.
Reichenberg, Zeitschrift des Nordböhmischen Gewerbe-Museums.
Röntgen Society, Journal.
Royal Agricultural Society, Journal.
Royal Asiatic Society, Journal.
Royal Astronomical Society, Memoirs.
Royal Colonial Institute, Proceedings.
Royal Cornwall Polytechnic Society, Annual Report.
Royal Dublin Society, Proceedings and Transactions.
Royal Geographical Society, "The Geographical Journal."
Royal Horticultural Society, Journal.
Royal Institute of British Architects, Journal.
Royal Institution of Cornwall, Journal.
Royal Institution of Great Britain, Proceedings.
Royal Irish Academy, Transactions and Proceedings.
Royal Meteorological Society, Quarterly Journal and Record.
Royal National Life Boat Institution, "The Life Boat" and Annual Report.
Royal Photographic Society of Great Britain, "The Photographic Journal."
Royal Scottish Society of Arts, Transactions.
Royal Society, Philosophical Transactions and Proceedings.
Royal Society of Edinburgh, Transactions and Proceedings.
Royal Statistical Society, Journal.
Royal United Service Institution, Journal.
Sanitary Institute, Journal.
Smithsonian Institution, Report and Publications.
Society of Antiquaries, Archæologia and Proceedings.
Society of Biblical Archæology, Proceedings.
Society of Chemical Industry, Journal.
Society of Dyers and Colourists, Journal.
Society of Engineers, Transactions.
Society of Public Analysts, "The Analyst."
South Wales Institute of Engineers, Proceedings.
Tramways and Light Railways Association, Official Circular.
Victoria Institute, Journal of the Transactions.
Wisconsin Academy of Sciences, Transactions.

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Weekly.

Amateur Photographer.
American Architect and Building News.
American Gas Light Journal.
American Machinist.
Architect.
Automotor.
Board of Trade Journal.
Bradstreet's.
British Architect.
British Journal of Photography.
Builder.
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Cabinet Maker.
Chemical News.
Chemist and Druggist.
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Cosmos: Revue des Sciences
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Electrician.
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Engineering News (New York)
Engineering Record (New York)

Engineering Times.
English Mechanic.
Gardeners' Chronicle.
Gardening World.
Graphic.
Grocer.
Indian Engineering.
Iron and Coal Trades Review
Journal of Gas Lighting.
Journal of Horticulture.
Lancet.
Mechanical Engineer.
Medical Press and Circular
Millers' Gazette.
Mining Journal.
Musical Standard.
Nature.
Notes and Queries
Page's Weekly.
Photographic News.
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Practical Engineer.
Produce Markets' Review
Public Opinion.
Queen.
Railway Times.
Review of the River Plate.
Revue Industrielle.
Royal Automobile Club Journal.
Sanitary Record.
Saturday Review.
Science.
Scientific American.
Shipping World
Spectator.
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Surveyor.
Textile Mercury

Fortnightly.

Agricultural News (Barbados).
Brewers' Gazette.
Corps Gras Industriels.
Finance Chronicle.
Irish Builder.
Jeweller and Metalworker.
Madrid Cientifico.
Perak Government Gazette.
Quinzaine Coloniale.
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American Silk Journal.
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Caterer and Refreshment Contractors' Gazette.
Coach Builders' and Wheelwrights' Art Journal.
Cold Storage and Ice Trades Review.
Commercial America.
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Councils' Journal.
County Council and Agricultural Record.
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Estate Magazine.
Fotografia Artistica (Turin).
Foundry Trade Journal.
Giornale del Genio Civile (Rome).
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Indian and Eastern Engineer.
Indian Review (Madras).
Indo-European Commercial Intelligence.
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International Sugar Journal.
Investors Monthly Manual.
Journal d'Agriculture Tropicale.
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Knowledge.
Leather Trades' Review.
Machinery Market.
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Mois Scientifique et Industriel.
Moniteur Scientifique.
Musical Times.
Oestereichische Monatsschrift für den Orient.
Paper Makers' Monthly Journal.
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Philosophical Magazine.
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Piano Journal.
Plumber and Decorator.
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Textile Manufacturer.
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Banbury Advertiser.
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Cape Times (Weekly Edition).
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Newcastle Weekly Chronicle.
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